MODERN PLASTICS

mp

OCTOBER 1941

PLASTICS REPLACE METALS!

Metals, so vital to our defense program, are being replaced more and more by injection molded plastics. An outstanding example is this handsome new floor lamp. Not only releasing metals for defense, and cutting out costly finishing operations — plastics offer a new wide range of colors and contribute brilliant luster to enhance the beauty of your product.

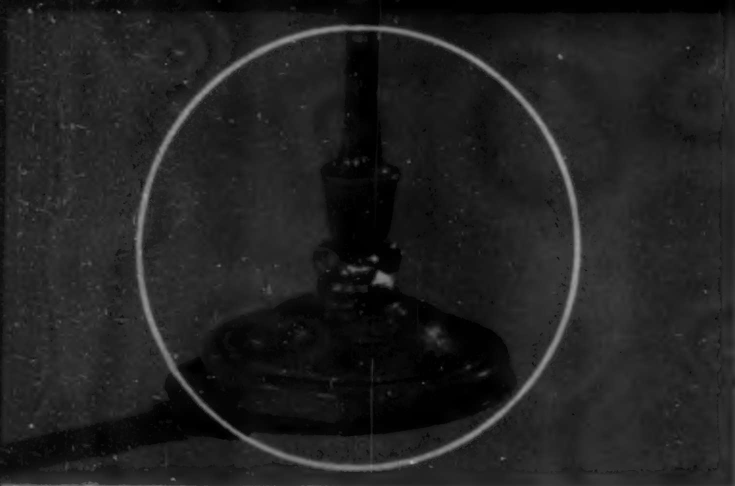
May we tell you more about Reed-Prentice machines? Detailed bulletins and proposals gladly submitted at any time.

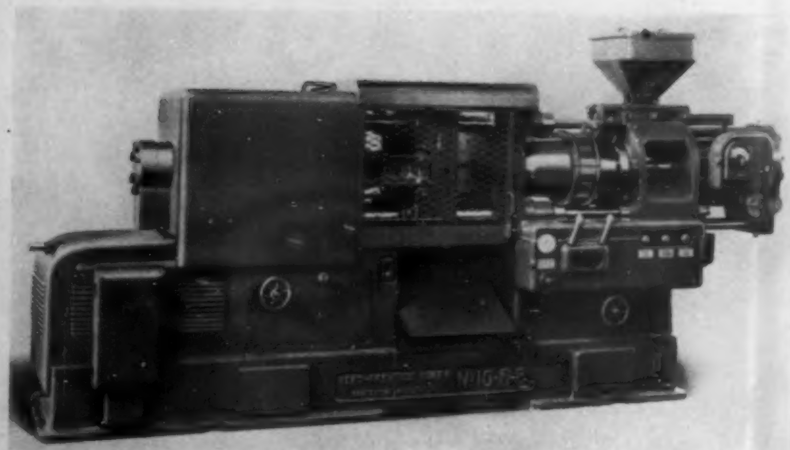
Reed-Prentice features covered by patents pending.

These outstanding lamp parts, and others too, are molded of thermoplastics for Colonial-Premier Company, Chicago, by Elmer E. Mills Corp., Chicago, Ill., where a battery of Reed-Prentice Injection Molding Machines is giving splendid service 24 hours a day.

IMPORTANT SPECIFICATIONS

Models	10A-4	10D-6	10D-8
Capacity	4 oz.	6 oz.	8 oz.
Injection pressure (Lbs. per sq. in.)	20,000	20,000	20,000
Mold closing pressure (Tons)	225	325	325
Mold opens	10¼"	10¼"	10¼"
Weight without elec. equip. (Lbs.)	10,000	11,500	12,000





REED-PRENTICE CORPORATION

WORCESTER, MASS., U. S. A.   New York Office: 75 West St.

435 MACHINES IN SUCCESSFUL OPERATION

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modern plastics

OCTOBER 1941

VOLUME 19 NUMBER 2

• GENERAL INTEREST

• TECHNICAL SECTION

• NEWS AND FEATURES

Cover colors this month, BRAZILIAN TOPAZ and WINDWARD GREEN (Created by Textile Color Card Association)

**NOVEMBER—
COMPETITION WINNERS!**

Watch for our special issue next month on the Sixth Annual Modern Plastics Competition for the complete story and pictures of this fascinating yearly event. Honorable Mentions, as well as winners, will be illustrated and fully described, thus giving the reader a comprehensive picture of Plastics progress for the year. Also of considerable interest will be our feature for the Technical Section, "Resistance of Plastics to Chemical Reagents." In addition, there will be the regular features, articles and news concerning the industry.

* Letter from the nation's capital from O.P.M.'s L. T. Barnette.

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A Super-Juicer of "Lucite"

SQUEEZING plenty of citrus juice from fruit—and lots of sales juice from its market—the new Dazey Super-Juicer owes much of its success to its "Lucite" construction.

This kitchen beauty comes—and stays—in bright hues women cherish for their workroom—sparkling reds, yellows, greens, and blacks that repel all siege by damaging fruit acids. Which, you'll agree, is one good boost for the "Lucite" methyl methacrylate molding powder used in making the juicer's major parts.

But that's only a beginning. This utensil is as pleasant and warm to the touch as it is cheerful to the eye—thanks again to the rare combination of desirable properties in "Lucite." It is light in weight, extremely strong and shatter-resistant. It is odorless, tasteless and chemically inert to fruit juices. It has all these advantages because its manufacturer had the sales wisdom to choose "Lucite."

From eye-glass frames to automobiles, from milady's heels to airplane parts, Du Pont plastics are just as indispensable as such basic materials as wood and metal. Experimental samples of Du Pont plastics and our experienced technical service are at your disposal. Write today for complete information. E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, N. J.

A STATEMENT BY DU PONT ABOUT PLASTICS . . .

• Defense requirements and unusual commercial demands exceed the supply of some Du Pont plastics. National Defense orders will get preferred attention, of course. But Du Pont is bending every effort to satisfy commercial and replacement needs. Shortages of equipment and raw materials necessarily limit this effort.

Du Pont is also instituting a broad research and development program. We believe that from this program will come improvements in existing plastics and the creation of entirely new types with new and valuable properties. The results of this research will be reported to you as they develop.

Stories of Du Pont plastics applications and developments will continue to appear in advertisements. We hope you will find it helpful to apply this information to your present and future needs. Meanwhile, experienced Du Pont technicians are ready to devote their knowledge and facilities to your product problems.

"Lucite" is Reg. U. S. Pat. Off.

DU PONT PLASTICS

Yes! Many Parts are Being Designed for

Automatic Molding

For moldings that must be put into production quickly . . . particularly for molded parts needed in defense work . . . it will pay to Mold Automatically, for a number of very definite reasons.

Automatic Molds, with one or few cavities only, can be made and put into use weeks ahead of big multiple cavity molds. They will have produced thousands of moldings before the larger molds are even ready to break in. They will save tool-makers' time also...plus expensive tool steel.

Automatic Molding saves molding labor . . . machines require only a minimum of attention. One man can take care of a big battery—a dozen machines or more.

Automatic Molding produces parts only as required. No large inventories are carried, therefore, no inventory loss is incurred when moldings must be redesigned.

Automatic Molding saves time . . . molding time . . . for cycles are reduced 50% or more in many cases, and output is increased in proportion.

Material savings are 8% to 10% or more . . . because every charge is accurately metered and there's very little flash waste.

Moldings are accurate and uniform . . . produced under identical conditions, without the element of human error to contend with.

Production is high . . . 10,000 or more moldings per week from a single cavity, because every split second of time is saved and machine operation is continuous, 24 hours a day and 7 days a week.

For these, and other good reasons, you'll find it profitable to design as much of your defense work as possible for Automatic Molding.

For defense jobs we have a special consulting service . . . to tell you quickly whether or not parts are suitable for Automatic Molding, to estimate costs, and to help you in Automatic mold design.

F. J. STOKES MACHINE COMPANY
5994 Tabor Road Olney, P. O. Philadelphia, Pa.

Representatives in New York, Chicago, Cincinnati, St. Louis, Cleveland, Detroit

Pacific Coast Representative: L. H. Butcher Company, Inc.

Stokes Completely Automatic Molding Machine. Patented and Patents Pending

F.J.Stokes MOLDING EQUIPMENT

FJS Est. 1895

Technicians are Often Amazed at the

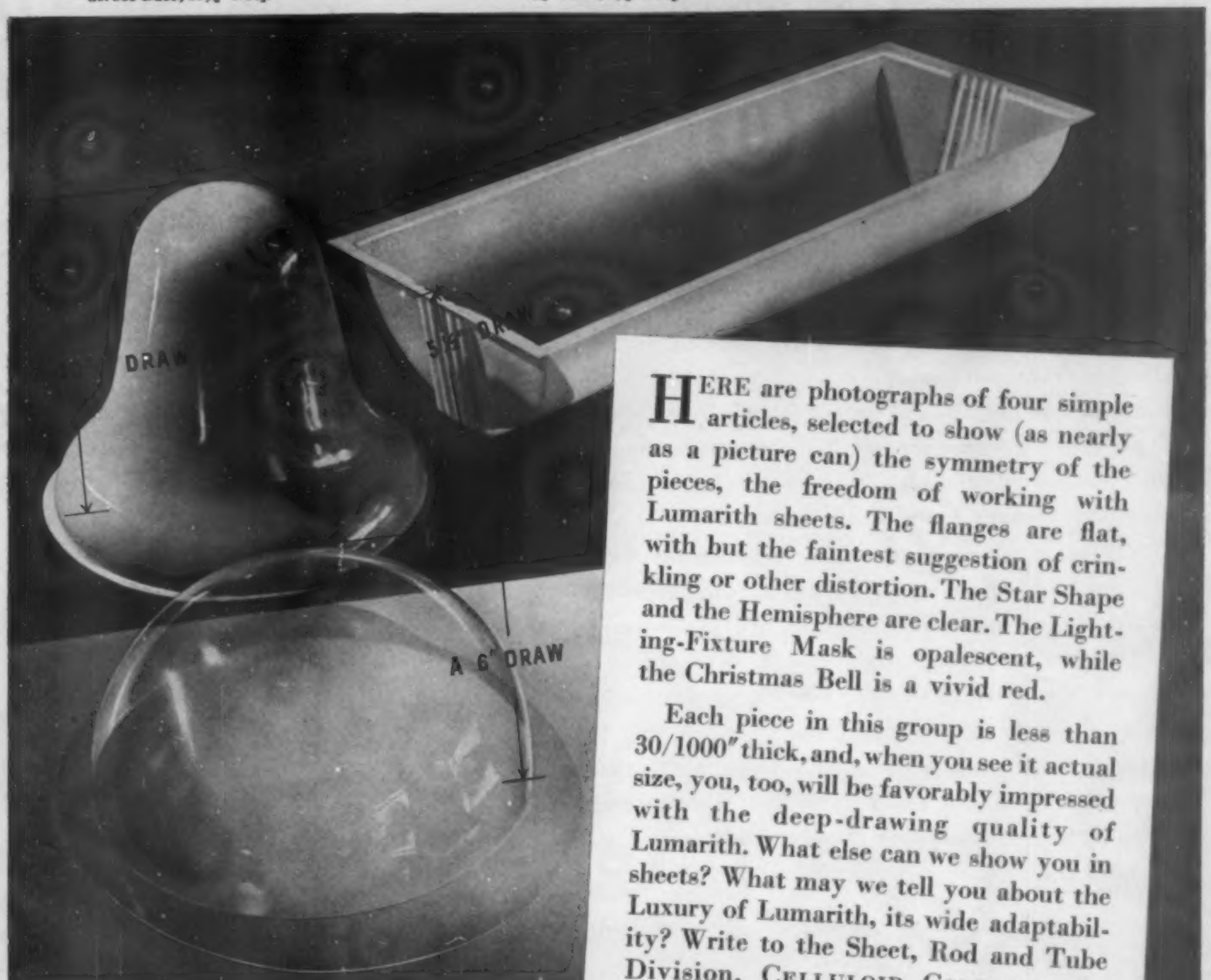
DEEP-DRAWING PROPERTY of LUMARITH

REG. U. S. PAT. OFF.

Christmas Bell (in Red), 11¾" across Base, 10¾" Deep

Lighting-Fixture Mask, Roughly 27" Long, 9½" Wide, 5½" Deep

Star Shape, Measures 11½" at Widest Point



Hemisphere for Advertising Display, 12" in Diameter

HERE are photographs of four simple articles, selected to show (as nearly as a picture can) the symmetry of the pieces, the freedom of working with Lumarith sheets. The flanges are flat, with but the faintest suggestion of crinkling or other distortion. The Star Shape and the Hemisphere are clear. The Lighting-Fixture Mask is opalescent, while the Christmas Bell is a vivid red.

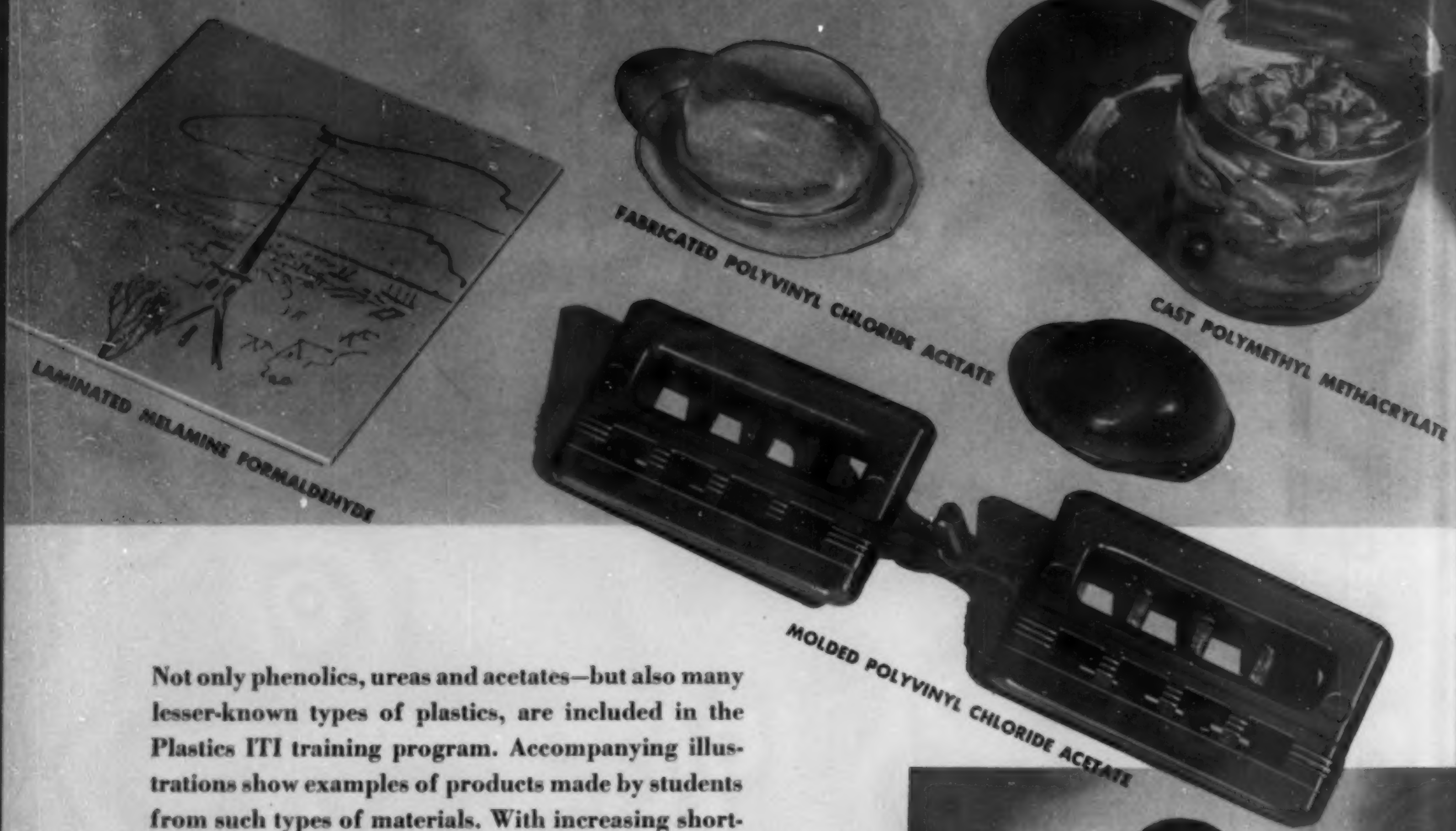
Each piece in this group is less than 30/1000" thick, and, when you see it actual size, you, too, will be favorably impressed with the deep-drawing quality of Lumarith. What else can we show you in sheets? What may we tell you about the Luxury of Lumarith, its wide adaptability? Write to the Sheet, Rod and Tube Division, CELLULOID CORPORATION, 180 Madison Avenue, New York City. Established 1872. Sole Producer of Celluloid, Lumarith, and Lumarith Protectoid. (Trademarks Reg. U. S. Pat. Off.)

When you think of Plastics, think of headquarters ... the "Grand-daddy of them all" and ...

Get in touch with CELLULOID

also Headquarters for Transparent PACKAGING MATERIALS

Plastics ITI Students KNOW MATERIALS



Not only phenolics, ureas and acetates—but also many lesser-known types of plastics, are included in the Plastics ITI training program. Accompanying illustrations show examples of products made by students from such types of materials. With increasing shortages of conventional plastics, a knowledge of other materials becomes increasingly important.

This instruction in materials includes the physical, chemical and electrical properties of each type of plastics—the applications to which it is particularly suitable and its limitations—available sources of raw materials—and the methods by which each plastic can be produced in commercial form.

Both theory and practical knowledge are gained from the classroom discussions and experimental projects in the factory-type shops and laboratories at Plastics ITI.

Plastics INDUSTRIES TECHNICAL INSTITUTE

182 SOUTH ALVARADO STREET...LOS ANGELES, CALIF.

One-Year Engineering, Short-term Day or Evening Courses, and Home Study (with or without shop training), are available. Write for illustrated literature.

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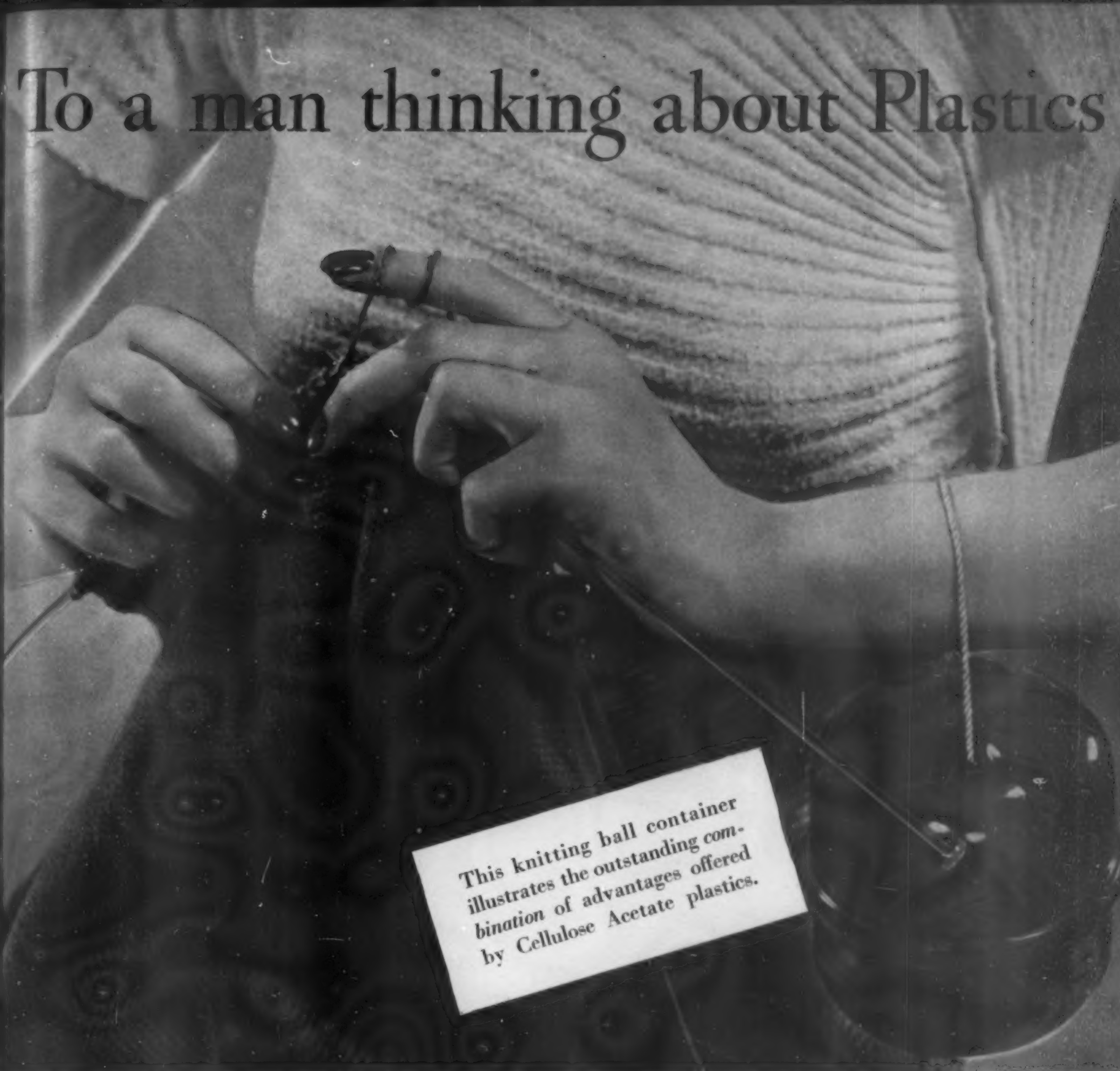
She shall have music WHEREVER she goes
thanks, in part, to
Lustron
Lustron is noted for its beauty—for the limitless range of its clear, true colors and its smooth, lustrous surface.
But it took more than beauty to win this assignment.
The cover of this new Firestone personal radio is molded of Lustron by the Superior Plastics Company of Chicago for two very practical reasons:
1. Since the radio's aerial is coiled inside the cover, Lustron's *dielectric properties* help effectively to reduce static wherever the radio is carried.
2. Lustron's *high dimensional stability* makes it certain that the cover will always fit, however wet or dry, however hot or cold the surroundings.
Other Lustron production-and-sales advantages that may recommend this versatile member of the Monsanto plastics family for a job in *your* products: resistance to acids, alcohol, cleansing alkalis, odorless and tasteless, no moisture absorption, adaptability to low-cost, high-speed injection molding.
For full details and the names of competent molders, inquire: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Mass.
District Offices: New York, Chicago, Boston, Detroit, Charlotte, Birmingham, Los Angeles, San Francisco, Montreal.
THE FAMILY OF SIX MONSANTO PLASTICS
(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)
LUSTRON (polystyrene) · OPALON (cast phenolic resin) · NITRON (cellulose nitrate) SAFLEX (vinyl acetal) · FIBESTOS (cellulose acetate) · RESINOX (phenolic compounds)
Sheets · Rods · Tubes · Castings
Molding Compounds
Vuepak,
Rigid Transparent Packaging Materials
LET'S GO! U.S.A. KEEP 'EM FLYING!
MONSANTO PLASTICS
MONSANTO PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

To a man thinking about Plastics



Any one of a number of materials might have been used for this two-piece, self-locking, knitting ball holder. But cellulose acetate plastic's *combination* of advantages helped make it a 1941 sales sensation, sold in chain stores everywhere. Consider these advantages:

LOW COST: Using cellulose acetate molding powder, the two halves of the ball are produced automatically, on speedy injection molding machines. They come out complete with bayonet catch slots, lugs, and locks. Time and labor are cut to the bone. Scrap is re-used.

STRENGTH: Although these balls weigh less than three ounces, with walls as thin as .040 in., they withstand repeated dropping and hard knocks. Their strong, tough resilience laughs at abuse.

BEAUTY: Cellulose acetate plastic may be of any color, transparent or opaque, or in jewel-like translucent tones that catch women's eyes and beckon to buy.

As a world-leader in the production of cellulose derivatives, Hercules research and production technique have made important contributions to the present-day high quality and versatility of cellulose acetate. To get the benefit of these advantages in *your* finished plastics, ask your molder to use a compound made with Hercules Cellulose Acetate Flake.

Write Department MP-10 for literature.

HERCULES
CELLULOSE ACETATE

HERCULES POWDER COMPANY · WILMINGTON, DELAWARE
Incorporated

28-hour

Simplify ASSEMBLY . . .

See how Assembly Engineering improved the assembly of this Salt Tablet Dispenser made by Fairway Laboratories. Nine P-K Self-tapping Screws assemble the component parts quickly, easily, securely. Applications include fastening a steel mounting plate, a transparent plastic closure and a Bakelite cover plate to the Bakelite housing. Elimination of inserts greatly speeded up the molding operation.

Save OPERATIONS . . .

Typical are the benefits reported by E. A. Meyers and Son, on assembly of a Tenite battery case for a hearing aid: Type Z and Type U Self-tapping Screws saved 50% assembly time and labor by replacing machine screws in tapped holes to secure contacts and clips . . . eliminated countersinking of 3 contacts, difficult tapping, stripped threads.

Cut out "SLOW-UPS" . . .

Your production won't be slowed-up by "doubtful screws" . . . screws that look all right but some of which fail to work right . . . when you use genuine Parker-Kalon Self-tapping Screws. For the Parker-Kalon Laboratory–without counterpart in the industry–maintains a rigid quality-control over all Parker-Kalon fastening devices.

SELF-TAPPING SCREWS FOR EVERY METAL AND PLASTIC ASSEMBLY . . . AND OTHER FASTENING DEVICES

"AND THE BAND ♪ ♪ PLAYED ON"

with new and improved plastic mouthpieces . . . to add clarity and fidelity of tone as well as beauty, durability and sales appeal. Produced in standard ebony black, ivory and crystal. We may be able to solve your sales or production problems with injection molded plastics. Write for information . . . no obligation, of course.

• • •

Injection molders of Tenite; Lucite; Lumarith; Plastacele; Crystallite; Vinylite; Polystyrene and other thermoplastic materials.

• • •

Our catalog illustrates many uses of injection molded plastics. Send for your free copy now.

MILLS PLASTIC PRODUCTS

ELMER E. MILLS CORPORATION

Custom Injection Molding Exclusively

816 W. VAN BUREN STREET CHICAGO, ILLINOIS


Beauty, Strength, Economy
REILLY
INDUR PLASTICS
In these strenuous days of production for national defense this company takes pride in the part Reilly INDUR Plastic Compounds are playing in the release of other needed materials for more essential production. Plastic products molded with these compounds are high in structural and dielectric strength and require a minimum of finishing. They are made in deep, lustrous blacks, and in a wide range of beautiful solid colors and mottles.
Products Molded by Terkelsen Machinery Co.
Reilly
COAL TAR PRODUCTS
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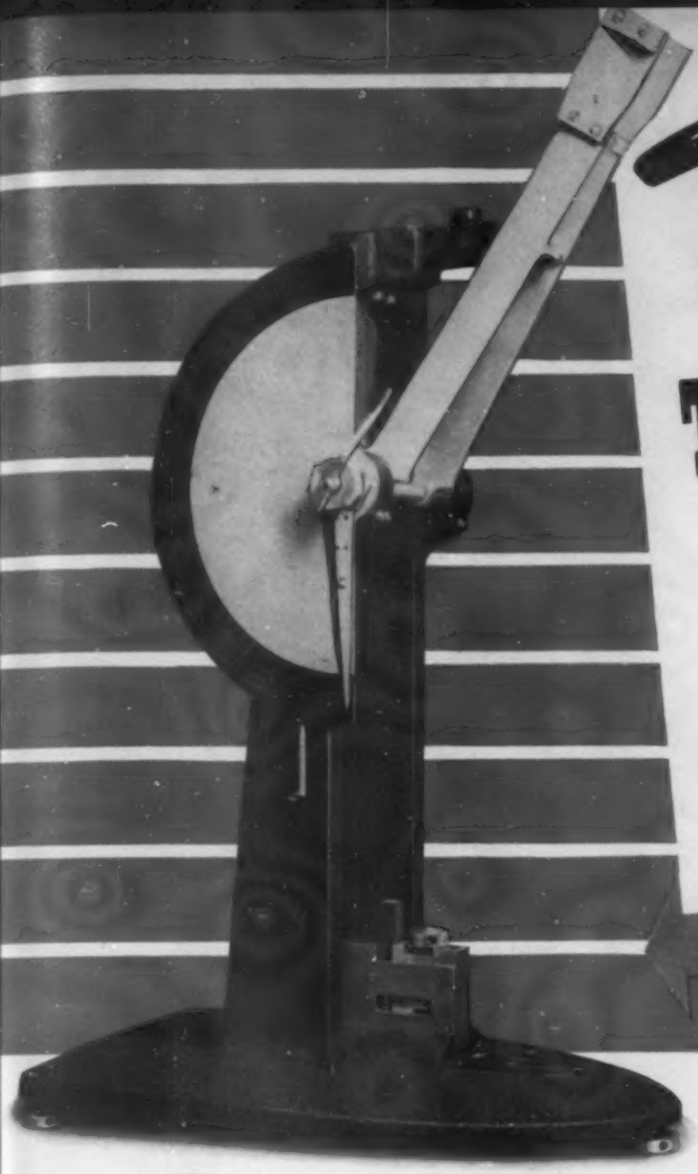
FIFTEEN · PLANTS · TO · SERVE · YOU



The IMPACT TESTING MACHINE *for* MOLDED MATERIALS

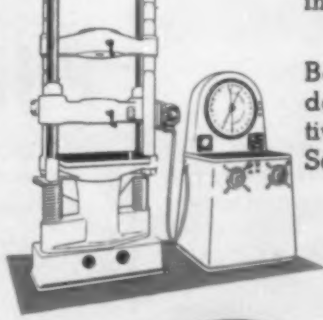
This Impact Testing Machine, incorporating design improvements made by Bell Telephone Laboratories, Inc., and built under Western Electric License, conforms to present Standards of the A.S.T.M. and is being continuously brought up to date as changes are authorized in committee.

Because its accuracy is guaranteed to be within 0.01 ft-lb for readings of less than 1 ft-lb and within 1 per cent for higher values; and because it is a rugged, precision-built instrument the Western Electric Impact Machine is widely recognized as the finest impact testing machine available.

Regularly furnished as a 2 ft-lb machine for Charpy, Izod or tension impact tests it is so designed that additional weights may be added for 4 ft-lb and 5 ft-lb tests.

Write for leaflet P147 and information concerning its application to your particular problem.

This instrument is a product of Baldwin Southwark, builders of the Southwark-Tate-Emery machine for tension and compression testing—America's fastest selling physical testing machine.



Baldwin Southwark Division of The Baldwin Locomotive Works, Philadelphia; Pacific Coast Representative, The Pelton Water Wheel Co., San Francisco.

Baldwin Southwark

DIVISION OF THE BALDWIN LOCOMOTIVE WORKS

PHILADELPHIA

BLW THE BALDWIN GROUP

FATIGUE & IMPACT MACHINES · EXTENSOMETERS · STRAIN GAGES · STRESS-STRAIN RECORDERS


ELMES
CHICAGO

Photo, Pan American Airways System

YOU can help to "KEEP 'EM FLYING"

Uncle Sam is urging that facilities heretofore used to fabricate "non-essentials" be swung over to defense. In many cases, existing equipment can quickly be readapted to vital needs of today, such as:

- Technical instrument applications.
- Scientific research material.
- Applications in the communications industry.
- Oil well and mining apparatus applications.
- Airplane accessories.
- A broad range of industrial, transportation and marine parts.
- Industrial, food and medicinal containers and protective coatings.

Cast phenolic resins have wide application among products, such as these, that are the "essentials" of today. Why not check into these possibilities and see how readily you can contribute your facilities to defense production?

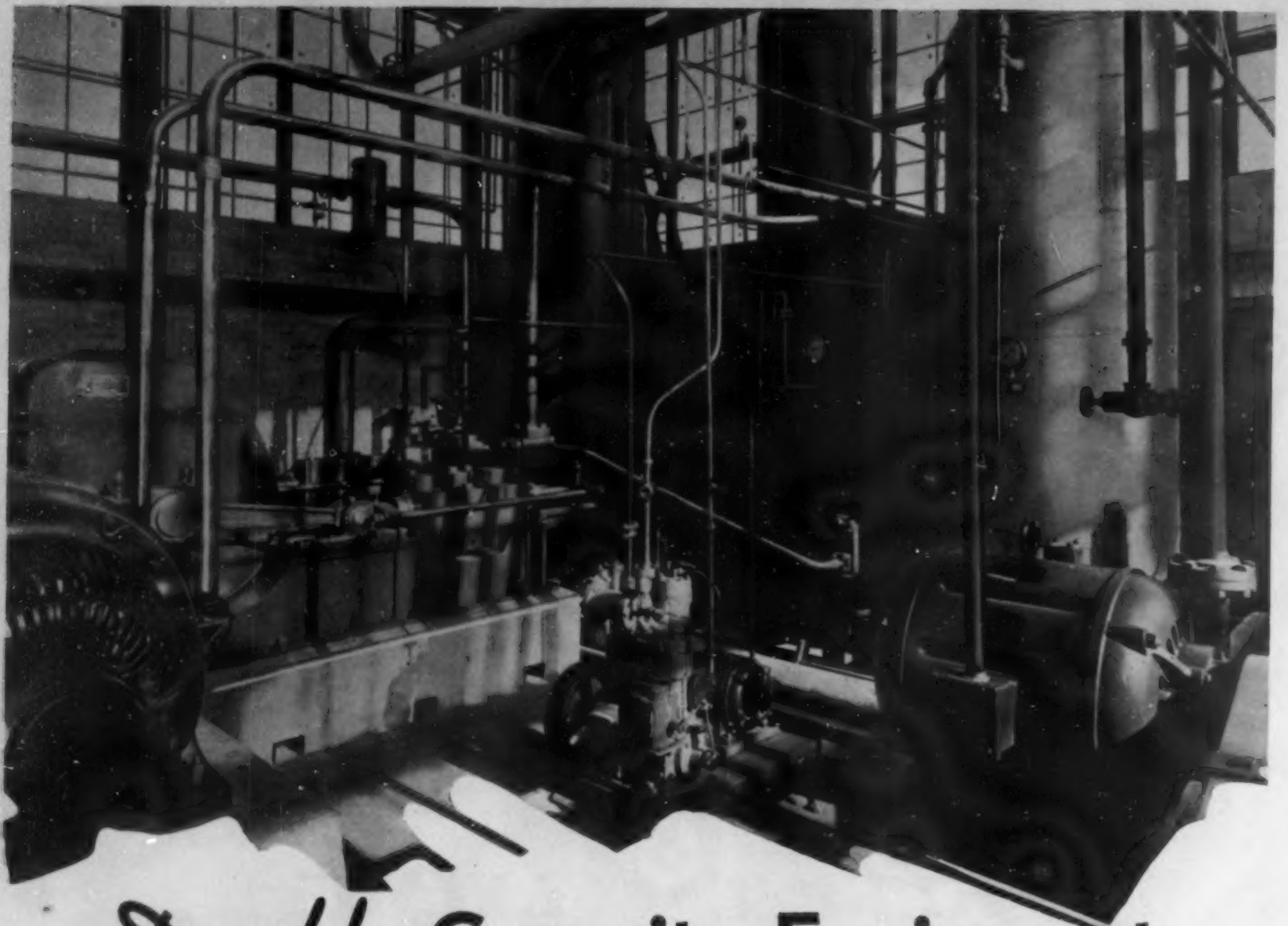
Along these lines, Marblette stands ready to assist you — and Uncle Sam — in any way possible. As a suggestion, this gasoline piston head is a typical application of Marblette in the defense program. Do YOUR part to "keep 'em flying".

MARBLETTE, *a pure phenolic resin without filters, is available in sheets, tubes, rods and special castings, in a variety of colors, in translucent, opaque, clear and mottled tones.*

Marblette

MARBLETTE CORPORATION · 37-21 THIRTIETH STREET · LONG ISLAND CITY · NEW YORK

sales offices: chicago, illinois • los angeles, california • toronto, canada • havana, cuba



Double Capacity Equipment *Protects* REYNOLDS Plastic Customers . . . .

As insurance to Reynolds plastic customers for prompt delivery, Reynolds maintains double capacity equipment. There are two air pressure accumulators, two high and low pressure pumps, two air compressors and two everything else needed to protect customers and assure continuous operation . . . .

LET REYNOLDS PROTECT YOUR PLASTIC PRODUCTION

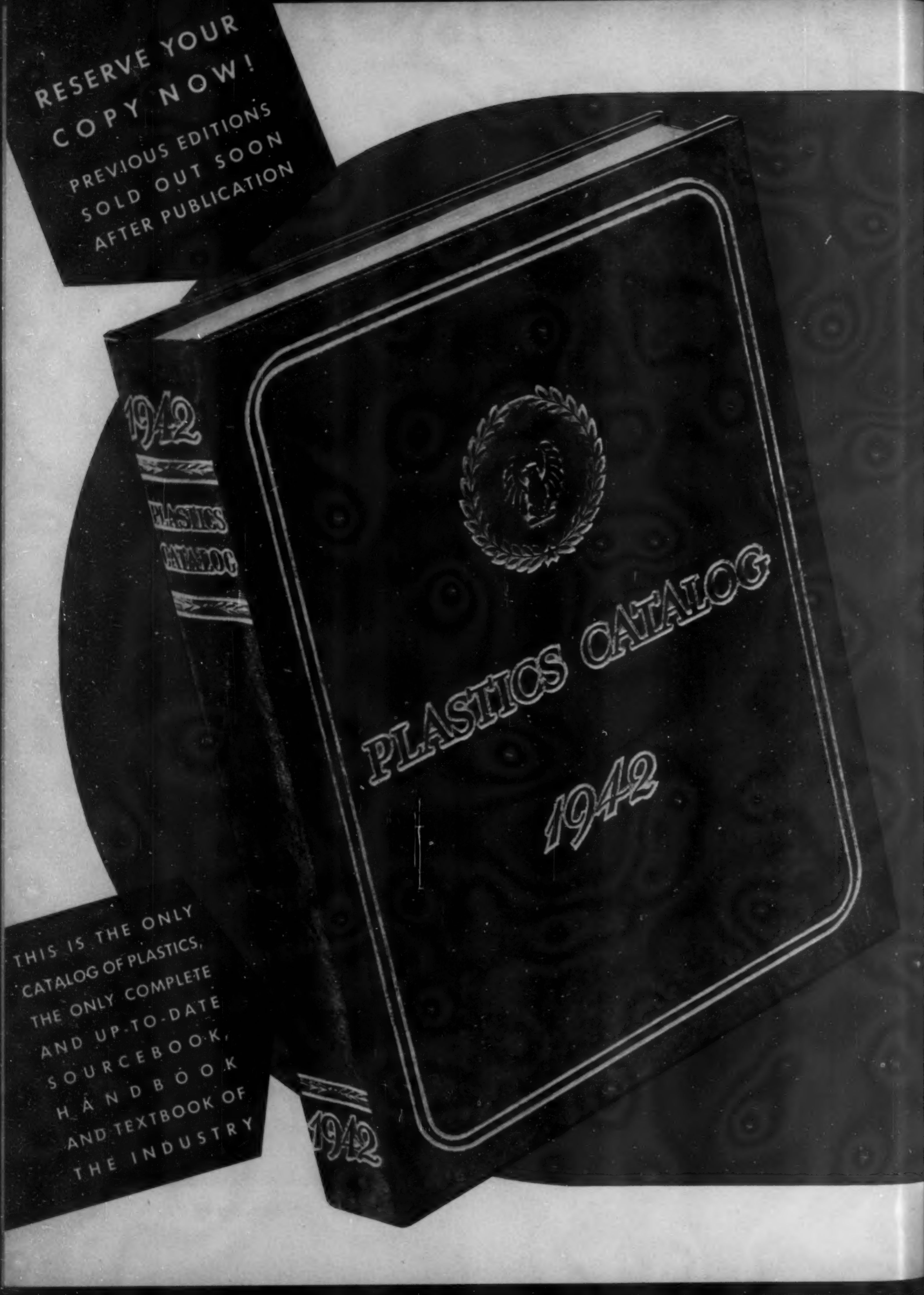
REYNOLDS MOLDED PLASTICS

CAMBRIDGE, OHIO, U.S.A.

DIVISION **REYNOLDS SPRING COMPANY**

JACKSON, MICHIGAN, U. S. A.


A NEW and EFFICIENT SUPPORT for the VITAL VOICES of the AIR . .
It has been the privilege of the Continental-Diamond Fibre Company to work with the Glenn L. Martin Company in developing...now in mass production... a DILECTO MOULDED LAMINATED PLASTIC RADIO ANTENNA MAST.
The final result not only answered what had been considered the prime requisite... but, also possessed other characteristics which proved of considerable value. The tapered design of the C-D DILECTO mast provides higher structural efficiency . . . better appearance . . . and this modern design is an engineering achievement presenting no manufacturing difficulties such as would be met in light alloy metals.
A few months from the time, the Glenn L. Martin Company first made their request... C-D had a suitable mast ready... for C-D has more than 30 years' experience in phenolic plastic.
Perhaps C-D's accumulated wealth of "Know HOW" in Fibre... Laminated and Moulded Plastics ...and other NON-Metallics may be helpful in solving your "What Material" problems.
Get in touch with C-D, #6 Chapel Street, Newark, Delaware.
Continental-Diamond
FIBRE COMPANY
"Manufacturers of Laminated Plastics Since 1911"
NEWARK • DELAWARE



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PREVIOUS EDITIONS SOLD OUT SOON AFTER PUBLICATION
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PLASTICS CATALOG
PLASTICS CATALOG
1942
THIS IS THE ONLY CATALOG OF PLASTICS, THE ONLY COMPLETE AND UP-TO-DATE SOURCEBOOK, HANDBOOK AND TEXTBOOK OF THE INDUSTRY
1942

OUR "GOVERNMENT REGULATIONS DEPARTMENT"

Established long before priorities began affecting the Plastics Industry, our "Government Regulations Department" has had but one purpose; the clarification of government rulings for the benefit of customers and prospective users of plastics. It has been the job of these men to gather evidence, clarify laws and executive orders, prepare appeals and print briefs of vital information so that our customers can be sure of prompt action and fair treatment as their orders are written.

When placing orders for defense work, it is of paramount importance that your supplier is thoroughly acquainted with priority rulings and defense red tape. On the basis of the experience already gained by our "Government Regulations Department" we can assure you of expeditious handling of your orders.

Custom Molders of all Plastic Materials by Compression and Injection Methods

CHICAGO MOLDED PRODUCTS CORP.

1046 NORTH KOLMAR AVENUE CHICAGO, ILLINOIS

MID WATCH

A. Molded-laminated truck wheel
B. Idler spool for airplane cabin control cable

Production Uniformity

and ~~VS~~ Low Cost Production

The ultimate in *production uniformity* need not be a thing apart from *low cost* production. Throughout the plastics industry, Birdsboro multiple platen sheet and general molding presses are daily combining the two.

The Birdsboro Hydraulic Presses shown here are some of many providing top-notch flexibility that combines *low cost* production with *uniform* production. If it's a press problem, ask Birdsboro.

BUILDERS OF

Hydraulic Presses • Special Machinery
Crushing Machinery • Rolls
Mill Equipment

BIRDSBORO

Hydraulic Presses

THE BIRDSBORO STEEL FOUNDRY AND MACHINE COMPANY • PLANTS AT BIRDSBORO AND READING, PA.

LOW MOISTURE ABSORBTION

STABLE DIMENSIONS

DECORATIVE APPEARANCE

INSULATING parts of Formica are the result of 28 years of concentration by a competent laboratory on the one problem of developing laminated phenolic insulating material. There are special types for special purposes. And all of them are produced under close control which assures quality and uniformity.

Formica's equipment for the production of sheets, tubes and rods is among the largest in the country, and fabricating departments for machining the material are also large and well equipped. Here is an excellent supply service for laminated parts — one that has no superior anywhere. Send your blue prints for quotations.

THE FORMICA INSULATION CO.
4673 SPRING GROVE AVENUE, CINCINNATI, OHIO

FORMICA

1—Interior view of the new Cadillac showing typical applications for 1942 model automobiles. Steering wheel is compression molded of cellulose acetate. Colorful radio control and other knobs are made of similar material, durable and easily cleaned

Detroit Unveiling

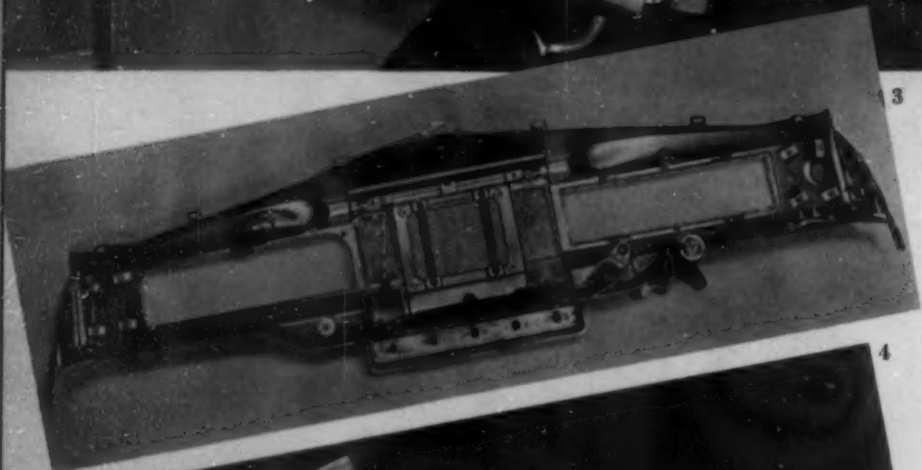
Plastics applications for 1942 models are forerunners of future developments for automobile industry

FACED with a 50 percent reduction of its last year's output, the automobile industry, under the jurisdiction of its new czar, Leon Henderson, has managed to supplement its defense efforts with some new passenger models of characteristic ingenuity.

Some months ago William S. Knudsen, speaking for the entire industry, promised a minimum of retooling in an endeavor to save expensive die work, thereby releasing both toolmakers and tool steel for more urgent uses. At the same time priorities on die-cast metals forecast an ultimate change in the coming models. Then, too, the problem of cutting in half a mass-scale production without greatly increasing the cost of the automobiles to the consumer, caused many gray hairs among many Detroiters. Mr. Edward Stettinius's February suggestion that plastics should be substituted for some of the now unobtainable metals was not wasted on the plastics-wise auto manufacturers, and the '42 models have borne this out to a certain degree already.

The season, however, is just beginning. Most of the engineers have their weather eye open to the changing situation. Though they feel that their supplies of raw materials are fairly well assured for the next 6 months, their laboratories, nevertheless, are constantly at work on substitutions so that a switch-over can be effected at a moment's notice should the necessity arise. Some be-

2



3

4

2—Chrysler's 1942 instrument panel is molded of cellulose acetate in sections and assembled with speed nuts to the metal dashboard. The glove compartment is molded around a heavy steel stamping with the sprue entering at the point where the lock fits into the insert. The sprue is consequently "cored out" in the finishing operation. A standard selection of 7 plastic colors is offered the consumer. 3—Rear view of this panel. Note the speed nut assembly. 4—Section of woven extruded thermoplastic material (rear) which forms the radio speaker enclosure and (foreground) injection molded strips used for interior decorative trim. 5—A view of the Chrysler plant showing battery of injection molding presses, one of the largest installations in the automobile industry

5

lieve the first pinch will be felt in December, others not till February; but few engineers honestly think that their last cars off the '42 production line will resemble in type or content of raw materials these first cars now being presented to the public as Motordom's Finest. True enough, the styles will remain undoubtedly the same, and they promise equal efficiency; consequently the change-overs will probably occur from time to time in such slight degrees that the consumer will be unaware of it. But in this period of change the use of plastics will without any question play an increasingly important role.

Very much of this opinion is Raymond Loewy, foremost industrial designer in the field of transporation. In his newly designed 1942 Studebaker he has used a transparent plastic radio grill.

"A survey of the 1942 line of automobiles," according to Mr. Loewy, "proves that styling is still the most salable single feature of automobile design. In spite of the restrictions on materials and processes, the 1942 automobiles show little evidence of the coming post-war revolution in design. American designers have been very clever in satisfying popular taste during the present condition of emergency. Within the next few years polished metal will, of necessity, be almost wholly eliminated from body styling. As a result, the public will be educated to the more chaste appearance of the standard body. Consequently, it is to be expected that even when materials are freed in unlimited quantities they will never again be used so lavishly as in today's so-called 'Deluxe' models.

"In all automobiles of the current season, however, certain design features have been conditioned by necessary adjustments in production. Zinc-base die castings have disappeared to be replaced by stamped parts. Contrary to the popular conception that this is a loss to distinctive design, stamping, well handled, can compare favorably with die casting in crispness and refinement of detail."

Of the 9 companies interviewed, all but one reported an increased use of plastics this year over the '41 models. This increase was invariably shown in the decorative applications where a sharp rise is noted in the use of acetates, acetobutyrates and acrylics. As a matter of fact, applications of acrylics on 1942 models have almost doubled. There are now 39 applications for 1941 models and there will be 70 on the 1942 models. It is expected that as manufacturers exhaust available supplies of chrome, they will turn more and more toward acrylics. Among the parts made from the material are radiator ornaments, parking lamp lenses, horn buttons, speedometer panels and dials; instrument cluster panels, clock panels and dials; medallions, radio lenses, Hydra-matic indicator dials, horn rings, name plates of various types and ornaments. Thermosetting applica-

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6—Packard Clipper instrumental panel: See-Deep process is used for horn button, speedometer dial and clock; ash tray panel and radio grille are molded of acetate. 7—Distributor head (right) on new Ford models contrasted to 1941 unit. Four lbs. of aluminum and approximately 1/2 lb. of soybean filled phenolic were saved by this change of design. 8—New Ford dashboard uses thermoplastic materials to replace bright trim

8

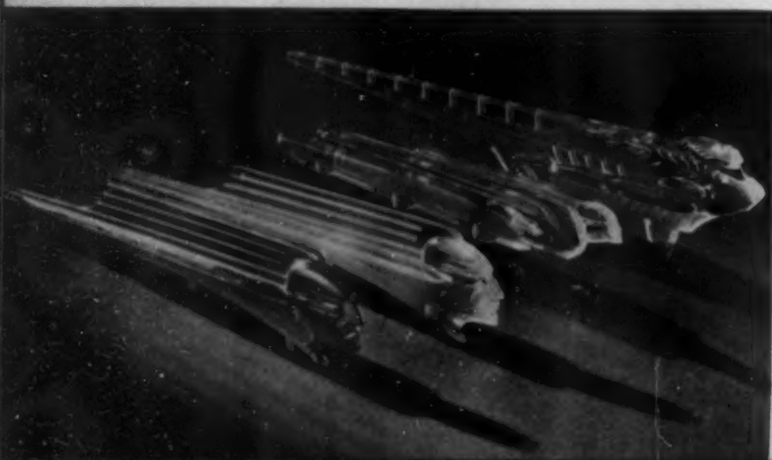
tions, both molded and laminated, remained, on the other hand, fairly stable. The reasons for this are obvious, since they are used mostly in conjunction with electrical assemblies, cam shafts, as washers, and insulation, and the idea was to change the fundamentals of the cars as little as possible this year. Ford offered one exception to this, however. Ford engineers had been considering for some time a redesign of their distributor head. It was based along altogether different lines and at the same time offered a considerable economy in materials, so they took advantage of the present situation and made the change-over in these '42 models. The new head saves nearly a half pound of phenolic molding powder and .4 pound of cast aluminum, second grade, (Table I).

Oldsmobile has listed 32 decorative applications for plastics in their new models (Table II). Outstanding in this list are the acetate window regulator handles and remote control (interior door handles) found in the majority of General Motors cars this year. Here is definitely an instance of plastics substituting for die-cast metals. Both the handle and the window regulator shanks are injection molded around heavy stamped

TABLE I. TYPES AND AMOUNTS OF PLASTIC MATERIAL IN A 1942 AUTOMOBILE

(Comparative '41, '42 Using Ford Super Deluxe as Typical Example)

Type of material	1941	1942
Phenolic molded parts	1.62 lbs.	1.20 lbs.
Laminated cloth	1.067 lbs.	1.067 lbs.
Laminated paper	.975 lb.	.975 lb.
Acetobutyrate	1.278 lbs.	1.937 lbs.
Vinyl safety glass filler	1.900 lbs.	1.900 lbs.
Methyl methacrylate	None	.046 lb.
Cellulose acetate	.020 lb.	.027 lb.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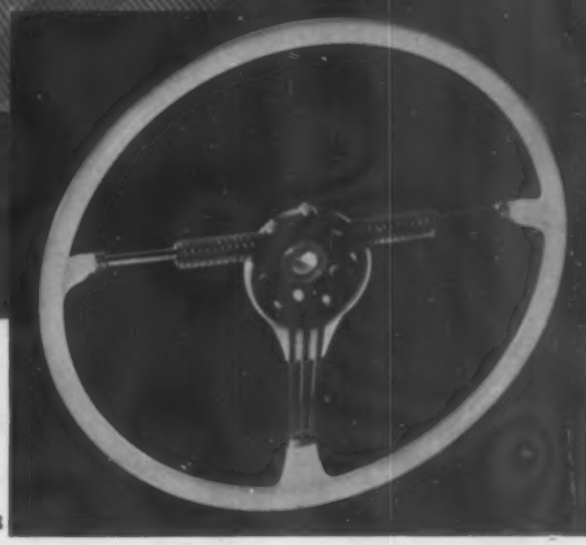
9—These streamlined pieces are becoming increasingly popular in the radiator ornament field. They are molded of acrylic resins, a material that is particularly appropriate because it is decorative, yet strong enough to withstand all kinds of weather. Extreme left is a metal-plated radiator top and directly behind is the original molding before the metal coating was applied. 10—Buick rear deck directional signal, molded of cellulose acetate butyrate, has metal letters inlaid by the Chilton process. These permit a 75 percent saving in metal letters alone. They are used for the first time on the outside of a car. 11—Acrylic directional lights on the Pontiac are a good example of injection molded thermoplastics in automotive use

12



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12—Lightweight, smooth and easy to handle, today's steering wheels molded of cellulose acetate supplant die castings. Two wheels at left have decorative centers of metalfoil and color by See-Deep process. 13—Rear view of Studebaker compression molded wheel, showing assembly of metal and plastic parts

steel inserts. Then they are "garnished" with knobs and escutcheons in various contrasting colors.

Oddly enough the main difficulty encountered here was color. Most of the upholstery on the various

Table II. Plastics in the 1942 Oldsmobile Models

1	Dome Lamp Lens	U†	20	Steering Wheel (A-B-C, Accessory)	A
2	Dome Lamp Switch Cover & Button	A	21	Horn Button (A-B-C, Accessory)	M
3	Regulator Knobs (A-B-C*)	A	22	Hood Ornament (A-B-C, Accessory)	M
4	Regulator Escutcheons (A-B-C)	A	23	Hydra-Matic Shifter Control Box Cover (Optional equipment)	A
5	Regulator Handles (A)	A	24	Hydra-Matic Shifter Control Box Cover Lens (Optional equipment)	A
6	Remote Control Handles (A)	A	25	Hydra-Matic Shifter Control Box Cover Screen (Optional equipment)	A
7	Rear Quarter Window Adj. Knobs (A-B-C)	A	26	Gear Shifter Knob—Hydra-Matic (Optional equipment)	A
8	Cowl Vent. Control Knob (A-B)	A	27	Heater Switch Control Knob (Accessory)	A
9	Ash Tray Lid Knobs—Rear Comp.	A	28	Defroster Switch Control Knob (Accessory)	A
10	Window Garnish Rail Medallion Insert (A-B)	A	29	Fog Light Switch Control Knob (Accessory)	A
11	Window Garnish Rail Medallion Insert (C)	M	30	Radio Tuning Knobs (Accessory)	A
12	Windshield Wiper Control Knob	A	31	Radio Selector Knobs (Accessory)	A
13	Hood Latch Control Knob	A	32	Aerial Escutcheon (Accessory)	B
14	Light Switch Control Knob	A			
15	Cigar Lighter Knob	A			
16	Gear Shifter Knob Std.	A			
17	Ash Tray Knob—Dash	A			
18	Glove Box Door (A-B-C)	M			
19	Cluster Lens (A-B-C)	M			

* "A" = Super De Luxe. "B" = De Luxe. "C" = Standard.
† Code: U—Urea; A—Acetate; M—Methacrylate; B—Butyrate.

T. W. Loring, Body Engineer

models embodies neutral shades, hence the natural desire for bright chrome trim on the hardware. In its change-over to plastics the G. M. styling department had hoped to take advantage of the myriad of colors obtainable in the acetates to compensate for the brightness of the denied chromium. But color tests showed that in many instances the neutral colors of the upholstery could clash just as easily as the brighter hues, and if anything gay in the line of plastics colors was used, it would require a whole spectrum full of shades to maintain a pleasing effect. This, of course, would means a serious complication in the production line since all Chevrolets and Pontiacs and the less expensive models of Oldsmobiles and Buicks are the cars on which this plastics hardware is placed. Finally the problem was solved by utilizing several neutral shades of acetate which tended to blend in with the upholstery than to "set it off" as has been the past custom with chrome trim. At present, costs on this new plastics hardware are running 15 percent higher than for die-castings, but this may be evened up later.

This question of plastics versus bright trim is highly debatable, has many angles, and must be carefully considered from the consumer's viewpoint before the manufacturer attempts his decorative design, since it is declared by most dealers as an all-important sales impetus. Chromium plated metal, from its popular inception more than a decade ago, has been the automotive industry's prime source for bright trim. At present the chromium situation is not exactly stringent, but, nevertheless, it is growing more and more acute. Detroit is consequently divided in its opinions as to the year's outcome. That they will always be supplied with enough for bumpers and essential parts, most manufacturers agree. Some, in fact, foresee no curtailment whatsoever in the near future.

Ford, always a staunch supporter of plastics, has replaced chrome trim wherever possible on the interiors of all the new models. This year the Mercury, the Ford Super Deluxe, Deluxe and Special will all carry acetate or butyrate radio grilles in addition to heavy plastics instrument panel bezels. Extruded acetate trim will again be used on the interiors.

Packard, on the other hand, is using less plastic on their new streamlined Clipper than last year. Their dealers demanded a brighter looking interior, and the Packard design experts felt they could best accomplish this with more chrome.

The most energetic user of plastics on the interior again turned out to be Chrysler. Their instrument panel, which won a Modern Plastics Award last year, returns on the '42 cars more brilliant than ever. Here there is no instance of plastics versus bright trim. The rich dark color of the upholstering is set off by an abundance of light acetate trim with a mottled effect. A noteworthy addition is the radio grille of woven extruded acetobutyrate reinforced with horizontal chromium bars. The glove compartment door which had been reinforced with a die-casting, is now being injection-molded over a metal (*Please turn to page 106*)

14

14—The 1942 Oldsmobile steering wheel assembly. The injection molded horn control is made in 2 cavity molds. The transparent plastic sprue is in foreground (right). Each half is painted in color and the entire back is lacquered over in gold to create a three-dimensional effect. At left, back of sprue section is shown after decoration has been completed

Obtaining defense contract work

L. T. BARNETTE

With all eyes on Washington, the Office of Production Management has been besieged with requests from the entire plastics industry for information on how to secure sub-contract defense work. By special permission, we reproduce here a letter to the Editor of Modern Plastics, from L. T. Barnette, Ordnance Branch, Office of Production Management, which presents in detail the circumstances and conditions as they exist today and suggests to the trade just what procedure to follow. Mr. Barnette, who early this summer accepted his present important post of correlating and assisting various governmental divisions in the plastics substitution program for national defense, was formerly associated with Standard Products Co., Thermo-Plastics Division.

September 17, 1941

Dear Sir:

On August 22, 1941, the first essential chemicals for the production of synthetic resins were placed under mandatory priorities. Such an order was issued due to the rapidly growing percentage of these materials which indirectly are going into Defense parts. This action tightened up deliveries of molding powders of the thermo-setting type to such an extent that it has brought home to the molding trade the need of receiving Defense business, either direct or indirect. Otherwise they may not be able to secure materials and maintain any sort of economic production.

In assembling a complete display of both direct and indirect plastic parts used in the Defense program, we have found that over 90 percent of these items are subcontract. In other words they are purchased direct or indirect by prime contractors and the various agencies here in Washington do not have particular information regarding them. Obviously the largest field in which to obtain orders for plastic Defense parts is the Defense Prime Contractors, and it of course is necessary for the molders to contact them in order to find out what parts are used and needed.

The Contract Distribution Division of OPM maintains 39 District Offices in 39 key cities throughout the United States. More may be added later. The molders should file descriptions of their facilities with the closest office or offices as a matter of record. These Regional Offices maintain a complete list of prime contractors which is brought up-to-date daily by dispatches from Washington. This means that to get action, the molders must secure the list and then contact these offices frequently in order to learn of new prime contractors and keep their lists complete. After examining these lists of prime contractors, the molders should select companies having contracts for Defense materials of a type which they can help to produce and contact them by personal visits, soliciting their business in the same energetic manner that they would go after commercial work. Regular bidders for Defense orders should be cultivated as the fact that they are prime contractors might mean that they are developing or working on something new for Defense in the production of which plastic parts will be required.

While these Regional Contract Distribution Offices may be of assistance to the molders in determining whether or not they can help certain prime contractors, if there is any question about it, the molders should be sure to contact and sell their services to them if practicable. Getting sub-contract Defense work is primarily a selling job and if the molders follow out this procedure promptly and frequently, they should be able to secure Defense work for their plants.

The fact that 90 percent of all plastics in Defense are sub-contract parts, indicates that industry generally is susceptible to worthy, economical plastic substitution. The molders' consistent efforts will enable them to take advantage of this fact.

We also recommend that molders contact and file descriptions of their facilities with the nearest Ordnance District Office or offices in order to be on the bidding list should any direct plastic parts be required.

(*The addresses of the Contract Distribution Division and Ordnance District offices are listed on pages 120 and 122.*)

Very truly yours,

L T Barnette

L. T. Barnette
Ordnance Brance, O. P. M.
Social Security Bldg.,
Washington, D. C.

The Editor
Modern Plastics
212 East 42nd Street
New York, N. Y.

Editor's Note: Mr. Barnette recently addressed a special meeting of the Society of the Plastics Industry in New York. Highlights of his speech and of the talks delivered by other prominent people in the industry will be found on page 98 of this issue.

National airport, Washington, D. C.

Laminated phenolics combine beauty and service in modern airlines terminal at nation's capital

MOST cosmopolitan of all terminals, with the exception of Lisbon, today is the recently opened Washington National Airport, where a steady stream of traffic passes en route to all parts of the United States. In keeping with the tempo is the modern construction and decoration which makes extensive use of laminated plastics—a material that "can take it."

Counter tops, wall paneling, doors, telephone booths are made of durable laminated plastic. Two colors are used throughout, Flat Cut walnut and Black. There are 1,575 sq. ft. of the walnut and 550 sq. ft. of the black. Some of the black has decorative silver inlays. In the main waiting room the material is lavishly used for the ticket desk (above). The plastic sheet was specified by the architect and shipped in the form of $^1/_{16}$-in. veneer sheets which are glued to plywood in a veneer press with casein glue to produce table tops, counter tops, counter panels, wall panels, doors and similar structural parts of fixtures and buildings.

At top of the page are shown the black laminated plastic counter tops with decorative turrets inlaid with silver; left center, a corner of the Presidential reception room in which the doors and walls were surfaced with laminated wood veneers of walnut; at lower left, telephone booths are surfaced with black laminated plastics.

Credits: Designer and architect, Howard Lovewell Cheney. Material from Formica Insulation Company.

Molded pulp resin products

Development and experimentation on plastic of unusual properties and strength for possible defense production

by W. E. PARSONS*

A UNIQUE plastic development which incorporates many desirable features is the new fibrous plastic material Kys-ite recently brought out by the Keyes Fibre Co. of Waterville, Maine. It is a molded pulp product carrying a synthetic resin content having all the advantages of the ordinary plastic molding compounds plus greatly increased strength and considerable latitude as to color and decorative effect.

Its applications are many and varied. The manufacturer is already producing and selling an extensive line of serving trays, although the actual objective is the more complicated industrial field. Some very interesting parts have already been produced for such products as refrigerators, cash registers, typewriters, radio sets, fans, cameras and electrical devices of various kinds. Several experimental projects are now under way for the defense program as well, and the material is receiving favorable consideration for certain significant purposes.

Keyes Fibre Co. has long been the leading manufacturer of molded pulp articles in America. It is only within the past year that it broadened its field to include this new fibrous plastic material. The base of the material is strong fibred pulp developed by a special process which combines the pulp resin in certain other forms. One of the particular features of the product is the development of the molded shape in its original form before curing, which means that however irregular it may be there are no stresses or strains set up at the time the article is cured—a condition which it is practically impossible to avoid when using ordinary sheets of impregnated paper or pulp and then reshaping them in the final steps of the process.

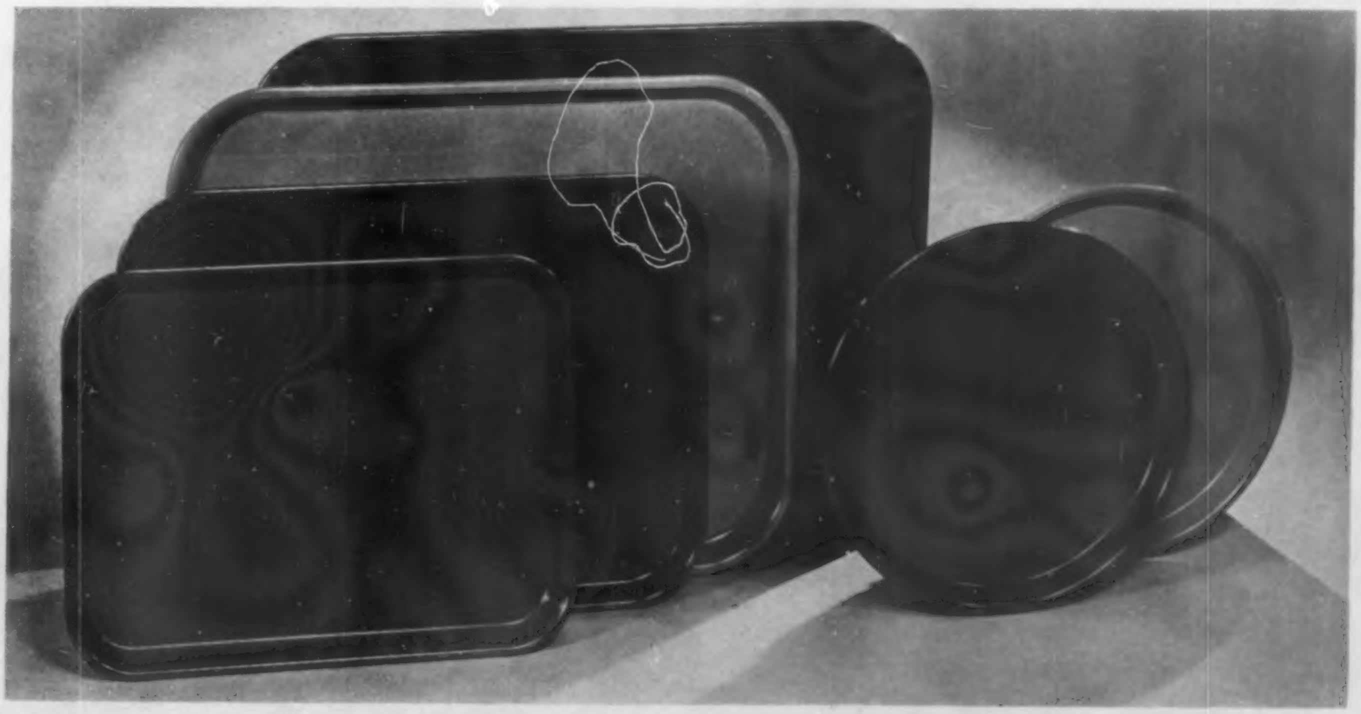
Severe tests which Kys-ite was put to before the commercial trays were offered in the market are interesting. One branch of the United States Government considering this product as a substitute for aluminum in the tray field subjected them to the following tests, which were completed without injury to shape or finish. Pieces cut from the center of the trays with the edges unprotected were boiled in the following solutions:

1. Government issue washing powder, in twice recommended strength
2. Four percent acetic acid plus 4 percent salt.
3. Two percent sodium hydroxide

The product passed rigid requirements of continuous boiling for 14 days with flying colors. This material is impervious to alcohol and can be cleaned readily with a damp cloth. Its appearance is comparable to any other plastic material and its (*Please turn to page 118*)

* General Manager, Keyes Fibre Co.

Tough, colorful serviceable trays for cafeteria, restaurant and hospital use, made of molded pulp and phenolic resin by a new patented process, point the way to industrial applications requiring great strength



Modern Plastics'

THE Sixth Annual Modern Plastics Competition, sponsored by MODERN PLASTICS magazine, is now open daily to the public from 10.00 a.m. to 4.00 p.m. and on Saturdays from 10.00 a.m. to 12.00 m., on the sixth floor of the Chanin building, 122 E. 42nd St., New York City, until the end of October 1941.

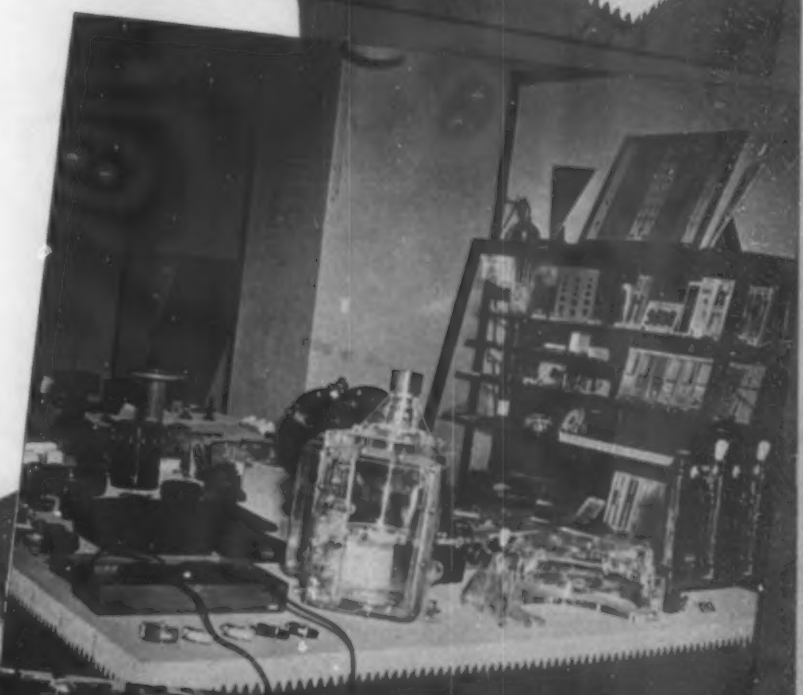
A board of judges, which included the country's foremost industrial designers, picked the winners and also awarded honorable mentions from some 900 entries submitted by industrial plants, manufacturers, designers, molders and fabricators in the United States. The winners are on exhibition, together with many other fascinating applications of plastics to contemporary life. From cozy little kitchen appliances to business machines and bombers, the gamut of plastic applications has been run. Entries are divided into 18 classifications. Some of them include Architecture, Business Equipment, Major Household Appliances, Military and Defense Transport and Industrial Applications. Keynote of this year's Competition is undoubtedly Defense and Industrial Applications.

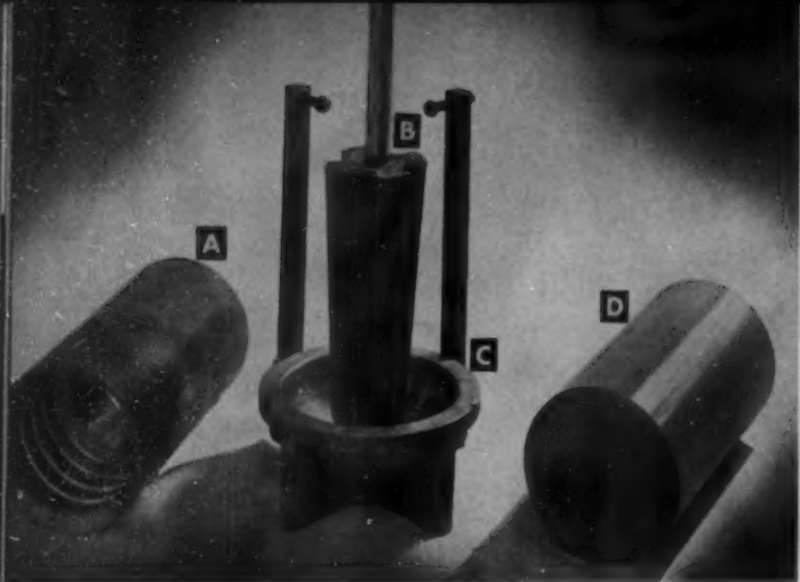
Annual Exhibit

The visitor will find plastics used for bombers, gun turrets, observation hatches, radio shafts, and sheaths for planes flying in depths of sub-zero weather.

Photographs on this page indicate the exciting display on view. There is something to interest everyone, no matter how exotic his tastes. Women will find one of the famous Cora Scovil manikins at the Exhibit. Although they have often seen their charming features in metropolitan department stores, there has been little opportunity to admire them close-up. The large group of radios pictured here will give the prospective customer a bird's-eye view of good functional design in the plastics field. Other corners of the Exhibition seen on this page include Defense Applications, Novelty and Decorative Objects and Architectural Applications—all significant in the light of National Preparedness, but equally important to the industry.

Complete descriptions and photographs of the winners and honorable mentions will be featured in the November issue. In the meantime, come and pick your own favorites!





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1—Mold assembly and casting for Baker Oil Tool guide shoe. *A*, forming cylinder, and *C*, nose of mold, are made of bronze. Core *B* is made of cast phenolic resin with metal shaft. *D* shows the 16-lb., 14-in. cast phenolic shoe with walls 4 in. thick. 2—Cast phenolic resin is used for the base *A* and core *B* in this casting mold. Collar *C*, because it molds the threads, and nose *D*, because it must be hammered off, are made of bronze. The cast phenolic shoe is shown at the right; top *F*, and bottom, *E*. Note the rugged ribs formed by the core within the casting

New jobs for cast phenolics

by E. F. LOUGEE*

Significant role may be played by this material in airplane production, oil drilling and other industries

UNTIL the beginning of this year, cast phenolics were thought of almost exclusively as decorative materials with depth of color and brilliance which recommended them for jewelry, chessmen, radio cabinets and decorators' accessories. To consider them as industrial materials, performing a definite job thousands of feet beneath the earth's surface, in mud-laden fluid perhaps a mile or more in depth, guiding a hundred-ton string of casing into the open hole of a new oil well, would seem incredible. Yet, today, they are being used for that purpose and are turning in such a good account of their service that other industries are making critical tests of the peculiar properties of casting phenolics, with the result that these resins soon may be used in place of zinc alloys as forming dies for metal airplane parts, and patterns for sand casting, among other things.

Casting phenolics were put to work under ground by Baker Oil Tools, Inc., whose main office and factory are located in Los Angeles, and who have been engaged in manufacturing oil tools for nearly thirty years. Oil wells are drilled through a succession of casings or pipes telescoped one through the other from the surface of the ground to the bottom of the well. Every so often a new string of casing has to be landed and cemented. On the bottom of each of these strings of casing a guide shoe is used to guide the casing to the bottom, where it is cemented in a special cementing operation requiring in some instances as many as 2500 sacks of cement to be pumped through the shoe in half an hour. After the cement sets, the shoe is drilled out. Most guide shoes are made of cement within a steel forging, but about two years ago the Baker engineers began looking for a better material that would be just a little more flexible and resistant to shock.

Many types of plastics were tried in their laboratory with varying results. With definite objectives in mind, Baker chemists and research engineers finally developed a casting resin having all of the characteristics desired except one—adequate physical strength. Research followed which brought the physical properties of the material into line, reduced shrinkage and cold flow, and now after nearly a year of service, these cast resin guide shoes, the company finds, are standing up better than any they ever made before.

A pilot plant, capable of making 30,000 lbs. of resin a month, has been set up and the liquid resin is stored in tanks until needed for casting. It is reported to be exceptionally stable and will remain in liquid form without any deterioration or hardening over a period of years. No inhibitor is used.

When ready for casting, the resin is mixed with walnut shell flour (up to 25 or 30 percent in volume) to reduce the cost per pound, a catalyst is added, and the resin is poured. The amazing thing is that it cures fully in less than two hours at a temperature of 175 deg. F. Smaller parts will cure in half an hour. The catalyst used has no effect on the strength of the material,

* Plastics Industries Technical Institute.

nor does it cause brittleness later on in the finished part.

Guide shoe castings weigh from $^1/_2$ lb. to 16 lbs. with wall thicknesses varying up to 4 in., including internal ribs which are cast integral with the piece. The shoe casting pictured in Fig. 1 (*D*) has a 4-in. wall and is 14 in. long. The approximate diameter of the piece is $12^1/_8$ inches. The core of the mold (*B*), excepting the inset shaft used for a handle, is also cast phenolic, but bronze is used for the nose of the mold (*C*) which has to be hammered off when the casting has set. The forged shell (*A*) gives the casting its cylindrical shape.

Some shoes are cast right into the steel forgings in which they are used in the well. They are cast around a molded phenolic ball valve mechanism through which cement is pumped for sealing the casing, holding it firmly in place and achieving a positive shut-off against intrusion of water.

A more complicated shoe is illustrated in Fig. 2. *E* and *F* show both ends of the cast phenolic piece weighing nearly 16 pounds. Clean-cut threads are cast in the mold and the piece is easily unscrewed from the mold collar when hard. The base of the mold (*A*), and the core (*B*), are both cast from phenolic material. Parts *C* and *D* are bronze. The core (*B*) weighs 4 lbs. as against $13^1/_2$ lbs. for the same piece in bronze—costs one-fifth as much. It is coated with phenolic paint to make it release easily although the natural shrinkage of the resin, which runs about seven-tenths of one percent lineal (see Properties Table, next page), helps too. Allowance for this shrinkage is made in the mold design.

Two grades of walnut shell flour are used in casting. The coarser grade gives greater strength while the finer grade reproduces finer details. Coarser grades are used for industrial castings and they faithfully reproduce all the detail required.

Experience gained in casting these large sections and the spendid performance of the resins in this industrial application have naturally suggested their use in other fields. Considerable experimenting has been done with this material to replace aluminum forms in match plate construction. The process has not been perfected but some actual production runs have been made, using a cast phenolic pattern to make sand molds (Fig. 3). The resin is more brittle, of course, than aluminum but with reasonable care phenolic patterns can be used over a long period of time, thereby releasing valuable metal.

Perhaps the most interesting implication of this entire development is the possible use of cast phenolic dies for forming metal parts in airplane manufacture. It is too

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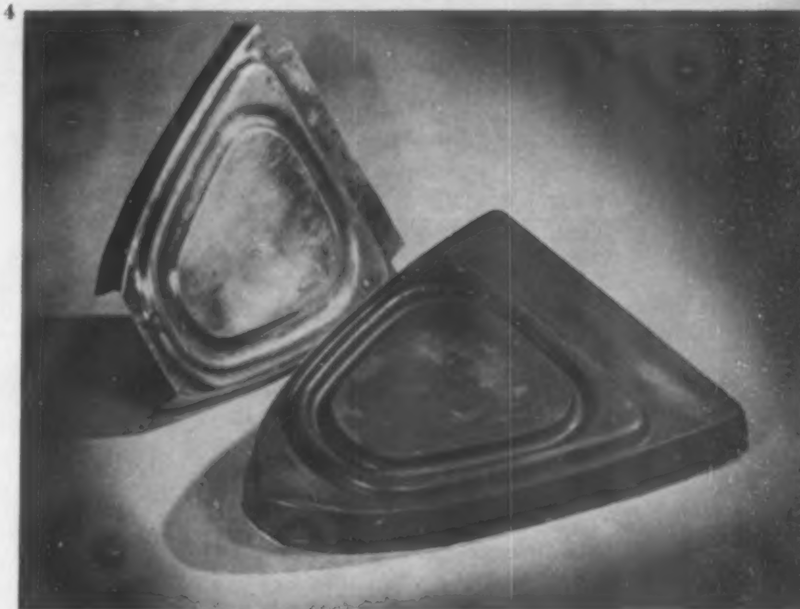

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3—Cast plastic match plate, being removed from sand mold. The plastic plate serves as a pattern to shape the green sand which is later filled with molten metal. (Photo courtesy Rezolin Co.) 4—Cast resin hydro-press forming die used experimentally to shape aluminum airplane parts. (Photo courtesy Douglas Aircraft Co.) 5—Plastic die used for bending aluminum tubing for aircraft work. The non-abrasive surface of the cast resin die leaves no marks on the aluminum tube. (Photo courtesy Northrop Aircraft, Inc.)

early to predict definite success but experiments recently completed show that pressures of 1200 to 2000 lbs. per sq. in. can be continually applied in the forming operation with no damage to the phenolic die. Figure 4 shows one of these dies which has withstood an experimental run forming several hundred parts, one of which is shown at the back. Another die, not shown, formed 500 pieces of stainless steel with no damage to the die. Figure 5 shows a forming block used experimentally to bend aluminum tubing in aircraft work.

Now if cast phenolics can be substituted for zinc alloys, they will make a substantial contribution to national defense. Furthermore, they may increase production by reducing man-power fatigue. A cast phenolic form block weighs but one-sixth as much as the same die cast in zinc alloy. This means that when operators are required to change dies several times a day, it takes two or three men to lift the alloy die, while almost any operator can pick up the cast phenolic piece and carry it under his arm.

The surface of the phenolic die is hard and smooth and requires little or no finishing after it is cast. Once a pattern is made, it is reproduced in a cast phenolic or plaster of Paris mold. As many dies may be turned out from this mold as are needed and every one of them will have the same smooth surface as the mold itself. They are also cheaper to produce. The phenolic material, with filler and catalyst ready to cast, at the moment costs 37 cents a pound. The average zinc alloy costs around 11 cents a pound; however, due to the difference in the densities of these two materials, only one-sixth as much by weight is required when this phenolic material is substituted for zinc. Therefore, since one pound of phenolic material costing only 37 cents replaces 6 pounds of metal costing 66 cents, the plastic die costs only $^{37}/_{66}$ as much.

It appears that there is no limitation of size for cast phenolic dies because a perfect mold can be made in any dimensions necessary to reproduce the original pattern. Once the mold is made, dies can be completed at the rate of one every 2 hours. Reserve dies can be held for replacement in case of accidental damage but there seems to be an ample safety factor since the clear resins will withstand 9,000 lbs. per sq. in. hydraulic pressure (Table I). The addition of 25–30 percent walnut shell filler reduces the strength slightly, but not enough to be damaged by repeated pressures of 2000 to 3000 lbs., which is ample for most metal pressing operations. Impact strength is a different matter. You can't bang these dies around with a hammer. Nor can you wham zinc alloys without denting them. Neither material is intended for such use. Cast phenolic dies cannot be used in a metal stamping press, but the slowly applied hydraulic pressure required for forming does them no harm—at least, up to now.

With priorities as the Nation's watchword, cast phenolics have laid aside their more common activities and volunteered to industry for the duration.

TABLE I.—PHYSICAL CHARACTERISTICS OF BAKER CAST PLASTICS

Types	100,089	100,089 30% D-50 WSF	100,042	100,042 30% D-50 WSF
Mold shrinkage, in./in.	0 to 8 $\times 10^{-3}$	8 $\times 10^{-3}$	0 to 9 $\times 10^{-3}$	8 $\times 10^{-3}$
Specific gravity	1.21	1.17	1.22	1.17
Specific volume in.^{3}/lb.	22.8	23.7	22.7	23.7
Tensile strength $^1/_4 \times {}^1/_2$ sample, lbs./in.^{2}	7000	3600	5100	2600
Elongation, percent				
Modulus of elasticity in tension, lbs./in.^{2} $\times 10^5$				
Compressive strength (lbs./sq. in.)				
Yield point	9000	8100	7400	6700
Ultimate	9600	8500	8600	7600
Flexural strength in lbs./sq. in.				
Shear strength, lbs./in.^{2}	4500	3800	4100	3500
Impact strength per in. of notch, $^1/_2 \times {}^1/_2$ in. notched bar Izod Test, ft. lbs.	.18–.36	.18–.36	.18–.26	.18–.26
Rockwell hardness, 60 kg., $^1/_4$-in. ball	....	....	70	40
Thermal expansion, in. $\times 10^{-6}$/in./deg. C.	9.3	9.3	10.4	9.3
Resistance to continuous heat, deg. F.	160°	160°	160°	160°
Softening point	None	None	None	None
Distortion under heat	....	....	....	....
Tendency to cold flow	None	None	None	None
Water absorption				
Burning rate	Nil	Nil	Nil	Nil
Effect of age		Hardens and Darkens		Hardens slightly
Effect of sunlight				
Effect of weak acids	None	None	None	None
Effects of strong acids		None except Nitric Acid		
Effects of weak alkalies	Slight	Slight	Slight	Slight
Effects of strong alkalies	Decomposes	Decomposes	Decomposes	Decomposes
Effects of organic solvents		Negligible		
Effect on metal inserts		None after hardening		
Machining qualities	Good	Excellent	Excellent	Excellent
Clarity	Opaque	Opaque	Opaque	Opaque
Color possibilities	Good	Dark colors	Excellent	Dark colors

1—The problem of finishing molded plastics by the wet sanding process is a complicated one requiring careful workmanship. The worker here is removing flashings around fingers and wrist of a glove form with a No. 280 Wetordry Tri-M-ite Cloth belt 120 in. by $1^1/_2$ in. Sprues, flashings and mold parting lines are removed

1

Finishing by wet sanding process

by G. E. WINTON and K. C. GULDEN*

THE need for a flexible coated abrasive for finishing plastic articles, that could be used with water, was first apparent 25 years ago. As a result of research on this subject begun in 1916, waterproof sandpaper was first made and offered for sale commercially in June 1921. In 1933 research efforts were directed toward development of a waterproof abrasive cloth that would have greater tensile strength than waterproof abrasive paper so that mechanical sanding with water would be practical. The physical characteristics of paper in regard to tensile strength and lack of conformability limited the use of paper to hand sanding.

* Sales Dept., Minnesota Mining & Mfg. Co.

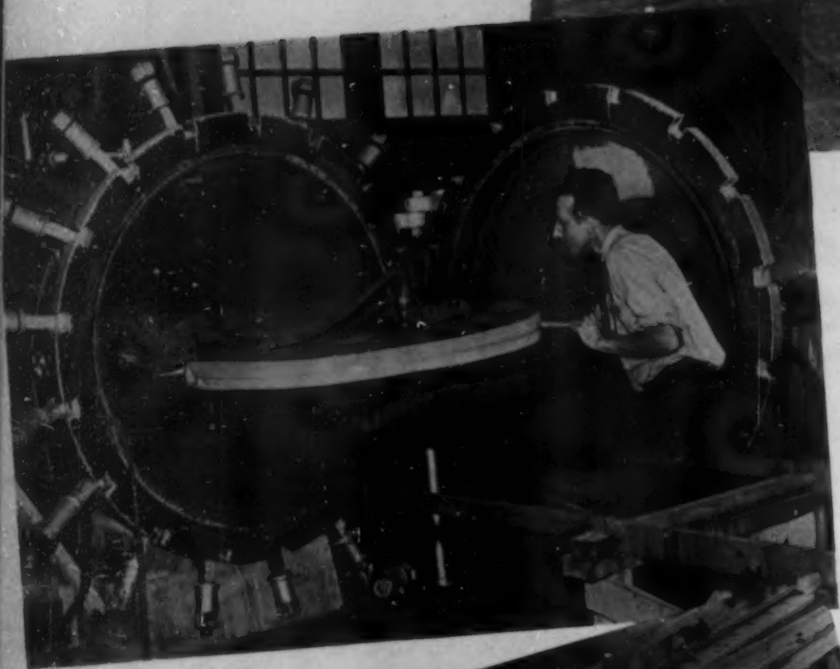
Wet sanding cloth was first made available to the molded plastic, molded hard rubber, glass and steel industries in Jan. 1936. It is a little-known fact (but a typical example of the many varied uses for synthetic resins) that the waterproofing of cloth and the bond for holding abrasive grain on sanding cloth is a synthetic resin. Both silicon carbide (Tri-M-ite) and aluminum oxide (Three-M-ite) minerals are used for abrasive coatings. The finished product is 100 percent impervious to water or, when used dry, the abrasive bond is not affected by frictional heat developed in dry sanding, it has been found.

The problems involved in (*Please turn to page 106*)

2

2—One can readily see the results obtained from finishing by the wet sanding process by examining these manikin's hands. The first one is finished; sprue removed, buffed and polished. The second and third examples show the amount of work that has to be done when the hand comes from the mold and before mold imperfections are removed

1



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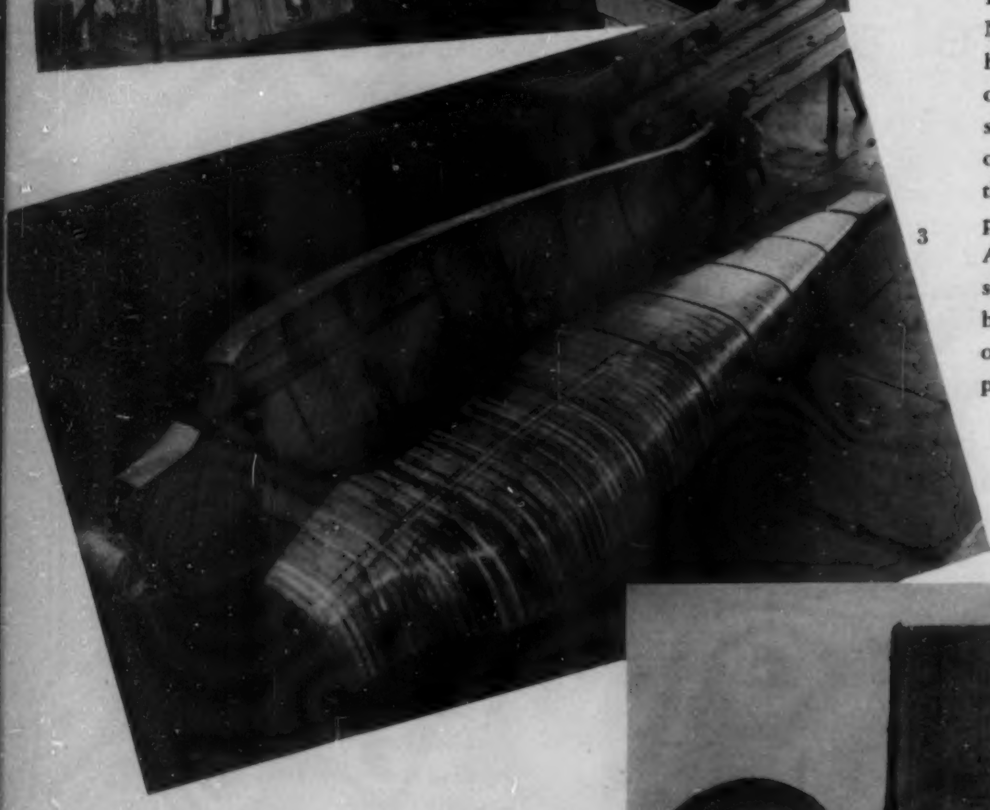
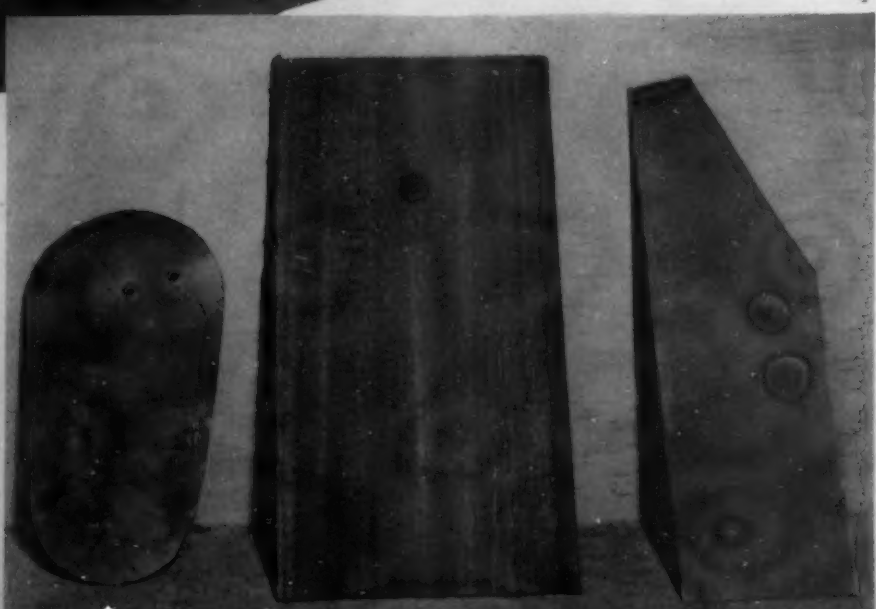


3

1—One of the intricate operations in making the twin-motored plastic-plywood plane—preparing plastic-plywood spars and other structural members for curing. The pieces are placed inside a rubberized fabric bag (on the table in foreground) and vacuum is applied. 2—Shapes made in the desired form are placed in the oven for curing. The door is securely fastened and heat and pressure applied for the required length of time. 3—Workmen removing the plastic-plywood fuselage from the wooden mold in the foreground. Note reinforcing members in the shell which have been molded into place. No metal fastenings of any kind have been employed. 4—The great strength of plastic-plywood is indicated by tests on these three pieces. They are about .0042 in. thick. Half-hard aluminum (left), three-ply plastic-plywood (center) and stainless steel (at the end). An acetylene torch burned the aluminum in three seconds. Twenty-two seconds were required to burn the center of the plastic-plywood and only one second for the steel. 5—Twin-motored plastic-plywood plane in full flight over the city

4



Twin-motored plastic-plywood plane

IMPORTANT stride in airplane construction has been made at Port Washington, L. I., where the Langley Aviation Corp. has turned out the first twin-motored plastic-plywood airplane which, aside from motors and other necessary metal fittings and gear, is made entirely of plastic plywood.

The Langley craft is an important addition to the list of aircraft companies now employing plastics as bonding agents in manufacturing airplane fuselages, wings and miscellaneous sub-assemblies such as nacelles, bomb doors and pontoons. The airplane takes its name from pioneer American airman Samuel Pierpont Langley. It is a four-place craft, mounting two 65-h.p. motors which give it a maximum speed of 142 miles per hour and a cruising speed of 125 miles per hour. The ship takes off in 200 ft., and lands at 46 m.p.h. A second craft, now under construction, will use two 90-h.p. engines and will have a top speed of 165 m.p.h. and a cruising rate of 148 m.p.h. It will take off in 175 ft. and land at 48 m.p.h.

While the Langley company has a license under the Vidal patents, their methods and results, according to officials of the firm, are entirely different from those previously obtained in manufacturing plastic-plywood structures under this system.

The molded plastic-plywood parts of the Langley ship are multiple layers of veneer, formed over a mold and permanently bonded together into a completed structure by plastic compositions which react in their characteristic manner to heat and pressure. Each of the integral members—fuselage, wings, control surfaces and cowlings—are joined without any mechanical fastenings such as nuts, bolts or screws. In place of mechanical dies, the Langley parts are made on relatively simple wooden forms or molds, prefabricated strips of veneer being placed over each other upon the forms while dry. On the mold, parts as big as half a fuselage are placed in a sack of rubberized fabric, each veneer layer being sealed with grains at right angles to each other in one hour or less in a heated pressure chamber. Although company officials would not permit publication of temperatures and pressures on grounds that they were "too revealing," the steps in processing a part are as follows:

1. Mold—All molds are made of wood. Sugar pine has been found to be a satisfactory material. Whether making a fuselage, wings or a nacelle, the mold is fabricated to the contour of the piece to be constructed. In contrast to conventional powder molding dies, where both a male and female die are necessary, only the male half is required for the unique molding process. The wood plies are laid on the wooden dies or forms. Depending upon the specified ultimate dimensions, as many thicknesses as necessary (*Please turn to page 110*)

5

Hose coupling device

Water high pressures and rough handling have little effect on Kup-L-Kwik, new molded plastic quick coupling device, used for service stations, homes and many types of water connections. Injection molded of cellulose acetate butyrate at small cost, the device is light weight, absorbs little moisture, has high dimensional stability and is tough in service. On service station work, the coupling has been the ideal hose and time saver. In the home it does yoeman service for the washing machine, and is especially good on lawns and gardens where one hose is employed to do all the work. For use of spray rigs, the locking device is claimed to have withstood up to 650 lbs. Vivid colors have been introduced to harmonize with outdoor furnishings and to improve general appearance. Although light, the coupling is sufficiently large and distinctive to be readily detected on the hose—thus retaining its identity and sales value. More than a substitute for similar metal devices, the plastic coupling is an improvement in function and looks. The device is made in two parts threaded to fit snugly on the hose and on each other. It measures $2^1/_2$ inches and is so light that even a woman with no feeling for mechanics can put it together.

Credits: Tenite II molded by Remler Co., Ltd., for John G. Vartanian

Product Development

Drinking cup dispenser

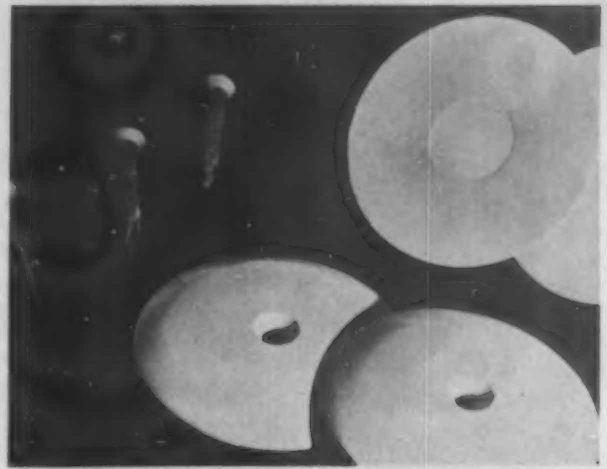
Before manufacturing a dispensing unit for a newly developed safe edge paper cup, the manufacturer drew up certain requirements. Among them were these: it had to be practically tight, so that a perfectly closed and sanitary unit would act as a container for the cups; and mounted on appropriate brackets capable of being opened for filling without removal from the supporting bracket. All these requirements were met in the dispenser that was finally developed. The outer body is molded of lustrous black phenolic. The inner shell is molded of black polystyrene. Molded parts are so designed that the two snap together in very tightly fitting grooves which are permanently joined by two small hardened self-tapping screws. The stamped metal back with the welded-on hinges are held to the housing with 6 of the same type screws, located in holes in the plastic which match holes in the hinges. The three small screws hold fast the aluminum strip. Because the bottom opening in the dispensing housing is forced to create an orifice through which the cups pass, removable pieces in the mold operate synchronously with the movement of the press. Thus, the side draw undercut is automatically produced.

Credits: Bakelite phenolic and polystyrene molded by Tech-Art Plastics Co. for Herz Cup Company

Traffic markers

Four years of experimentation have resulted in Saf-T-Dots, street traffic marker with an acetate base which fulfils all the requirements drawn up for it on the part of its inventors. They decided that the marker had to be white throughout, indestructible in all traffic, unaffected by moisture, non-absorbent to oils, resistant to acids, somewhat resilient, non-yellowing from sun or age, stable of form in summer heat, serviceable after 4 years, dense enough to prevent imbedding of dirt in its surface and manufactured to sell at a nominal price. In appearance it is dome shaped, $4^1/_2$ to 5 in. in diameter and $^5/_8$ in. thick. The markers are as easily used on the road as paint to form lines, symbols or words and, of course, much more economical. Street lines must be constantly repainted, but the buttons once set down, are permanent. A line broken at intervals with a row of buttons has been found easier for the motorist to see than one continuous line. Furthermore, white paint lines are blotted out on a glistening wet pavement. The markers are unaffected by fog, slime or mud, because of the raised, rounded surface and density of the material. Saf-T-Dots are also used in marking crosswalks, center lines and sidelines.

Credits: Hercules cellulose acetate. Designed by J. F. Shafer and Robert Foster for Saf-T-Dot Marker Company



Product Development

Preselector drum

As its contribution to nation-wide aluminum conservation drive, The Warner and Swasey Co. are now using a molded phenolic material as part of turret lathes. Newly developed and thoroughly tested for its efficiency is the plastic drum for the Preselector which informs the turret lathe operator, in terms of surface feet per minute, the speed of the work on which he is cutting. Use of this material renders the lathe stronger. The Preselector is a device on the turret lathe headstock which permits the operator to preselect his work speeds and shift gears and operate the clutches and headbrake with a single lever. The drum, which is so essential here, was formerly made of aluminum, requiring many precision machining operations in the finishing of aluminum casting. With the new molded plastic Preselector drum dial, only one simple drilling operation is required, and there is an obvious saving. In the normal output of this Preselector drum over 1400 lbs. of essential aluminum are released for defense needs every month. Moreover, there is approximately 80 percent saved in manufacturing cost. With plastics the ribs inside the castillations are reinforced by the pressure mold shaping of the drum itself—impossible with aluminum.

Credits: Bakelite phenolic molded by Reynolds Spring Co., Plastics Division

Half ton baker's loaf

Spectacular bread display unit, air-conditioned and lighted, revolves on bakery building roof

A LOAF of bread with the paper torn invitingly open to reveal its crisp freshness, formed from acrylic sheets, shines over the General Baking Co. building in Philadelphia, Pa. It is said to be the "world's largest loaf of bread," 7 ft. by 7 ft. by 21 ft.

The plastic loaf rotates slowly, and at night is illuminated (as shown above) from within. Installation includes two large neon reproductions of the "Bond" trade name and a number of smaller signs throughout the building. Decision to use plastics was made over a year ago and later proved especially fortunate when the shortage of metals became acute. The original decision, however, was based on other considerations. The savings in weight, for example, were considerable and permitted lighter construction in the turntable mechanism. Even with the use of acrylic, the assembly weighs half a ton. The material is particularly good for this application because it will stand up in all kinds of weather.

Sheets were also easier to form and fabricate than metal. Acrylics become pliable at about the temperature of boiling water and can be formed to shape in smooth plaster or wooden molds. When it cools, it retains the shape of the mold. The transparency also permitted effective use of lights. The whole loaf was painted on the outside so that the Spectacular would show the golden brown bread projecting at one end as though the wrapper had been folded back. At night, lights inside the bread illuminate the whole loaf.

Great care was taken to make the sign a faithful reproduction of an actual loaf of Bond bread. Signs are cut to scale and scale models trimmed on standard band saws. On each end of the loaf the trade name appears in small letters. The assembly itself was easily done. Since acrylic sheet cuts like wood or soft metal, no special sawing equipment was necessary. Overlapping the joints gave strength and rigidity to the assembly and since the sign stands 3 full stories above the street, the overlapped joints were concealed very well with paint. On smaller assembly jobs it is possible to make transparent cemented joints.

Credits: Design and construction by Frederic Weinberg and Croasdale and de Angelis. Sign fabribated from Plexiglas sheet for the General Baking Company.

From 9 to 5

Widespread acceptance of plastics in major business machines by leading American manufactures revealed in survey

A TREND toward plastics for their own worth and not necessarily to replace metals used in defense industries is the consensus of 20 leading business machine manufacturers to whom a questionnaire was sent. To quote the engineering department of one of the most outstanding corporations in the world, International Business Machines, is to summarize what is practically a majority opinion:

"We in I.B.M. have become increasingly conscious of the progress that has been made in the plastics industry and feel that there is no question but that many new applications will be found in our equipment for various plastic materials. In the past, many of the plastics which we had used were primarily utilized because of their dielectric properties. More thought is now being given to the use of plastics from the standpoint of weight, appearance and cost."

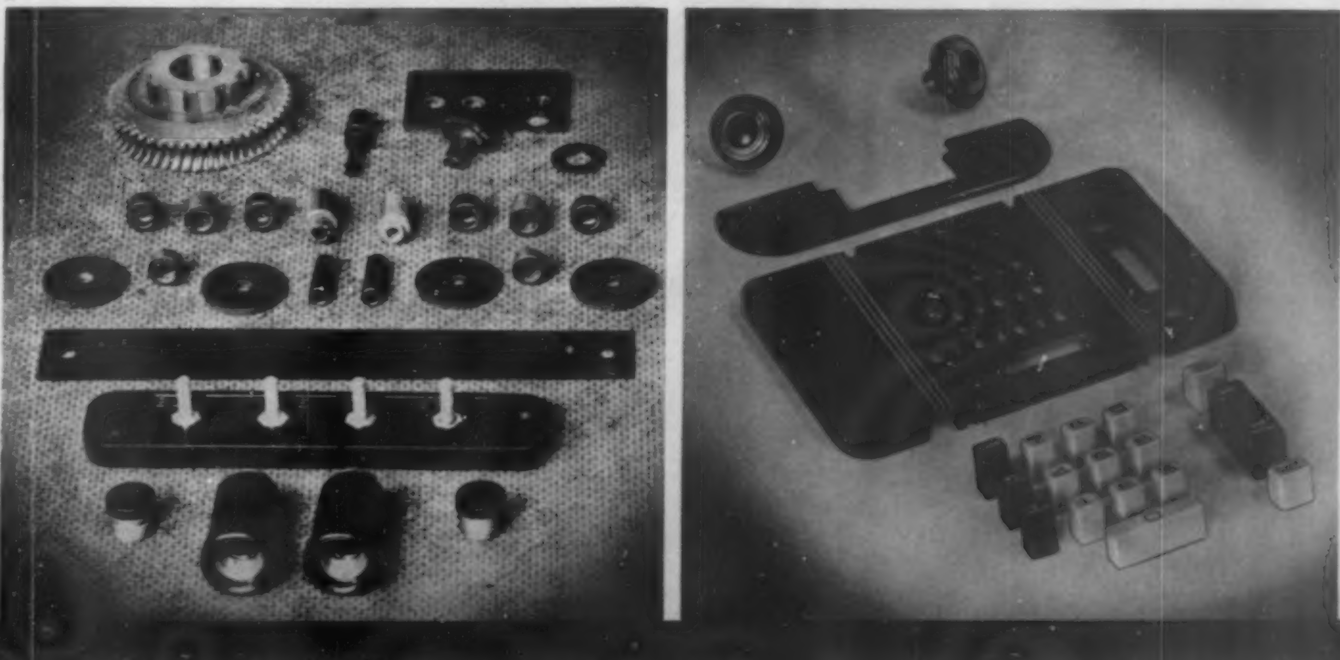
Important redesign jobs have looked to plastics for additional quality and strength. New designs have been turned out increasingly in plastics by the country's foremost manufacturers. Among these are the adding machine housings, typewriter parts, mechanical calcu-

1—Graphic illustration of distinguished accomplishment in external redesign is shown in the illustration of the Underwood-Sundstrand adding machine formerly made of metal (left) and now housed in plastic (right). Note how cumbersome detail has been eliminated and a streamlined housing takes its place. 2—Precision molded parts (right), and fabricated (left), make up the perfect mechanism to provide an easier operating, faster and quieter machine

1

RESINOX

2



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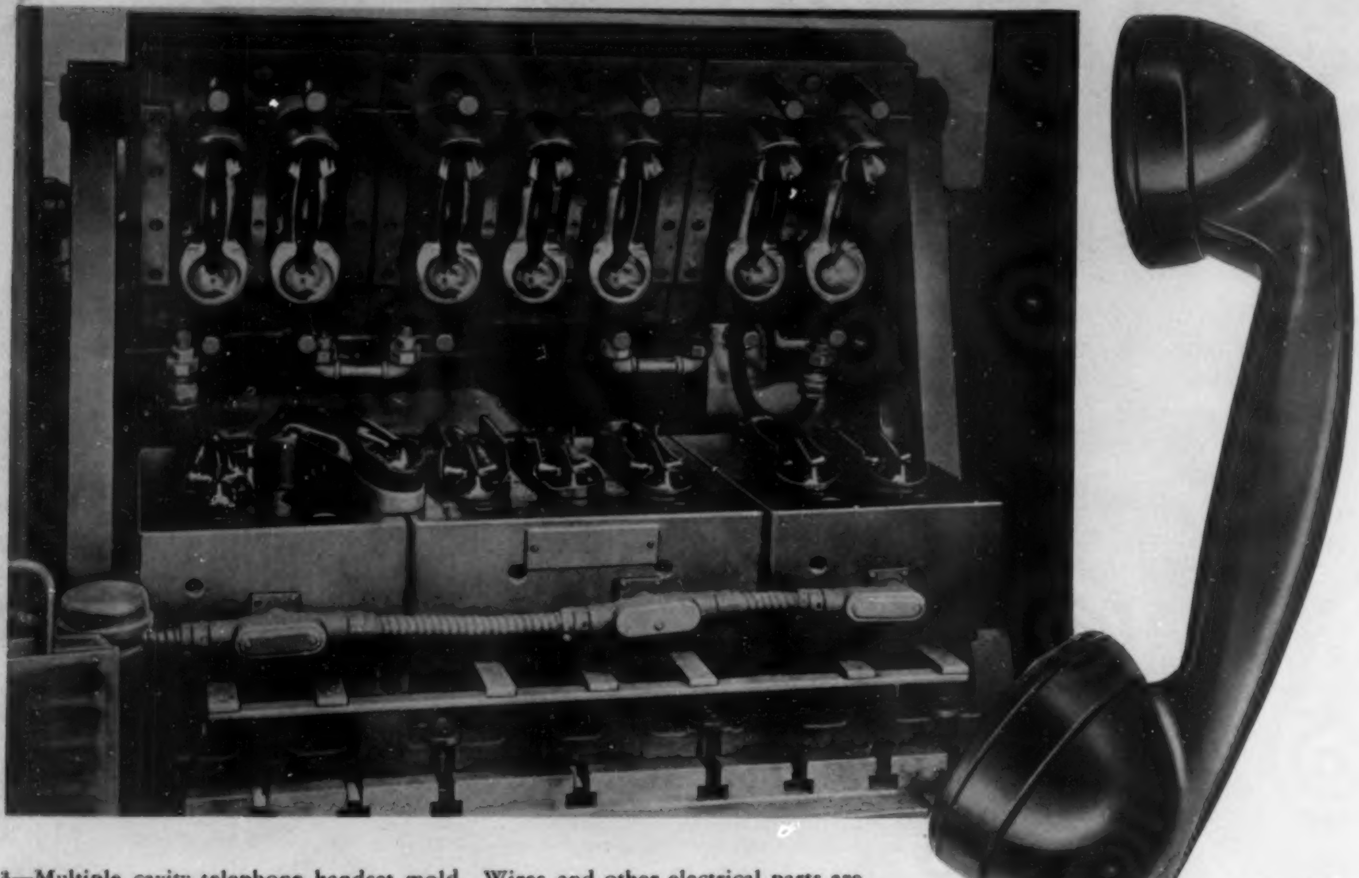


3—Multiple cavity telephone handset mold. Wires and other electrical parts are placed in position before mold closes. In this manner they become securely affixed in their permanent position. The handset is trimmed after molding by a machine operation

lator keys, telephone apparatus, dictating machines and a host of office equipment supplies and devices, some of which are pictured and discussed in this story.

Underwood-Sundstrand adding machine

An outstanding example of a redesign job using phenolics to the best advantage is the Underwood-Sundstrand adding machine which is now more durable, faster, quieter and cheaper to make because of its 48 plastic parts.

Walter A. Anderson, chief engineer of Underwood Elliott Fisher Co., the manufacturer, lists numerous reasons for change to a molded phenolic housing from an enameled aluminum shell. First of all, better appearance and lower costs resulted from the change. The use of molded phenolics eliminated 17 operations resulting in a reduction in cost of maintaining tools, fixtures, etc., otherwise required to produce aluminum cases. Other important points are: noise reduction; does not scratch like enamel; unsightly appearance caused by enamel wearing in spots—a thing of the past with plastics; better re-sale due to unchanging appearance, reduction in weight, an important factor because machines are often carried from one spot to another; easily enameled if needed—choice of colors and elimination of a great deal of handling work.

The machine was designed in 1939 after considerable experimentation was done on the molding job. The molded case is so designed that the skirt around the base of the machine has enough allowed clearance all around so that variations in the case will not affect the parts inside. It will not cause binding between the base and the case either. Although the housing is made by a molder, the wrinkle finish is applied by the company and baked in ovens at an extremely low temperature to prevent warpage.

It will be interesting to the reader to see the "Before and After" picture (Fig. 1). Basic parts (Fig. 2, right) are molded. Those at left are a mixture of fabricated and molded parts. Altogether, the machine uses 24 molded plastic parts and 24 parts fabricated from laminated sheets and rods, namely: housing, carriage knob, ribbon cover, keyboard plate, keytops, terminal plate, worm gear and fabricated parts used for electrical connections. Formerly a bronze worm gear was used. There was always difficulty in machining them as well as excessive wear when the drive unit ran dry of grease. In addition, the metal to metal contact of the hardened steel worm against the bronze worm gear was excessively noisy. After the change to laminated cloth phenolic, this was corrected. The hardened steel worm running in the plastic gear becomes saturated with oil or grease which makes it run quietly and for a greater period of time with a minimum of wear.

Molded phenolic was chosen for the special charac-

teristics of this plastic—non-conducting qualities for electrical connectors, dimensional stability, moldability and resistance to chemicals. The terminal plate is a molded piece with 4 terminal post inserts. This construction greatly réduced costs as it was possible to make it in one piece instead of building up insulated units in the manner of the previous construction. The motor brush cap and brush holder are molded phenolics over inserts and the knobs are molded phenolic around stainless steel inserts. The ribbon cover is also molded phenolic. The keyboard top plate was a more involved molding job than the rest of the machine. "0" keys are molded from cellulose acetate and the 9 figure keys of cellulose nitrate. Ivory plastic is used for figures, and ivory and black for control keys.

If it had not been for the use of plastics, according to W. A. Anderson, it would have been impossible to produce and release the machine at such a low figure.

"Because of our use of plastics," he said, "we have effected a considerable saving that has not only been a benefit to us, but also to our customer. In addition to this, in view of present world conditions and the shortage of certain materials, we have been fortunate in not having to depend upon a depleted source of supply, which might have been disastrous to us. Due to the quantity of machines we produce, there has been no curtailment of plastics as yet.

"It is gratifying to realize that we have arrived at the stage in the development of plastics where jobs that were once considered impossible are now possible and where plastics can now be spread over an even greater range than heretofore."

Victor adding machine

Among the most successful machine housings of plastics are the two types of Victor adding machines, the Full Key Portable and the Ten Key Portable.

Newest innovation in the machine is the switch from the inset metal plate keyboard to an all-plastic housing for the Ten Key Portable. The redesign job was done by William Petzold[1] who has worked extensively with

[1] General Electric Co., Plastics Dept.

4 TENITE

4—Calculating keys injection molded of cellulose acetate. 5—Ten Key Portable Victor calculating machine (left) with inset metal plate keyboard. In the redesign job (right) phenolic housing with key openings is molded in one piece to fit over the metal base and, although part of the mechanism, so designed to ride free of the actual workings

5 BAKELITE

TEXTOLITE

plastics in a variety of designs. It is his opinion that plastics do their best job by integrating the mechanism design with the housing design. And it is just that which has been done on the Ten Key Portable. It is molded in one piece to fit over the metal and, although part of the mechanism, it rides free of the workings.

"In this job, as in nearly all cases, we had to be sure," said Mr. Petzold, "that the mechanism proper was mounted in such a manner that no undue strain was put on the plastic part. The mechanism itself had to be complete, and the plastic housing just a shell which fitted over it, but not used as a structural part. If this is not done, we run into trouble of breakage through shipment or in actual use of the machine if it should receive any amount of abuse. Such abuse would accentuate the stresses already set up in the poor assembly design and result in breakage."

Although the appearance of the Ten Key Portable leaves nothing to be desired, Mr. Petzold believes that design in a business machine is secondary.

"We might be extremists and say that appearance in the design of a business machine is secondary, although the obvious outcome of good functional design is good appearance. To amplify this statement—we can by no means, in working with plastics, simply arrive at a mass which, from the standpoint of design is very pleasing. Instead, we must examine very carefully every portion of the mechanism itself."

Using plastics as widely as he does, Mr. Petzold has come to certain conclusions regarding their use at this time. He thinks that today, as never before, designers must do an exceptional job if they want future business. It is the misapplication of plastics in these times, where manufacturers use them because of metal scarcity, that does the industry little permanent good, he believes.

The Bell Telephone Co.

Pulse of the modern business office is the telephone over which the nation's business is conducted. This instrument depends almost entirely on organic plastics for the manufacturing of apparatus and equipment.

Although rubber was at one time the most universally used insulating material in telephone apparatus, its use was considerably curtailed as a molding material during World War I due to the high price. This stimulated the substitution of phenol plastics which were found to produce more permanent parts. The great expansion of the use of molded plastic parts in the telephone plant really began with the development of organic materials which had superior manufacturing and structural characteristics over other materials. Phenolics have been employed in the molding of the regular telephone handset, recent production being in excess of 1,000,000 units per year. Cellulose acetate is widely used in foil form. Plastics in the form of synthetic organic finishes are used for protection, decoration and insulating purposes on apparatus and equipment. In a monograph[2] recently issued by the Bell Telephone System, plastics in the telephone plant may be grouped as follows:

1. Molding plastics.
2. Sheet materials (phenol fiber, acetate foil, etc.).
3. Synthetic organic finishes, adhesives and miscellaneous special items.

The molding plastics and sheet materials account for the bulk of the plastics used in the telephone plant. Excellence in a majority of properties is required by the company for the ideal plastic in the telephone industry, whether it is in the hands of the public, the plant or in a telephone exchange:

General requirements are: strength, hardness, toughness; low density; chemical inertness in air, or in contact with other materials; resistance to humidity (minimum of swelling and shrinkage with variations of moisture content of the air); ability to withstand temperature, heat and cold, without too great impairment

[2] "Plastic Materials in Telephone Use" by J. R. Townsend and W. J. Clarke, Bell Telephone Laboratories.

6

6—A panel system commutator of shellac-mica composition manufactured by means of a flash die. The positive die consists of a plunger and a cavity shaped to produce the finished part. Only enough material is placed in the die to make the part

7

7—A terminal block used to terminate the subscriber's telephone cord is made from strong insulated molded cellulose acetate material. Gates are trimmed off by a simple trimming punch and the scrap is reused

of strength and shape; ability to reproduce die surface accurately and give good appearance to finished part; light stability; relative non-inflammability; no odor, no harm to the skin; resistance to insect attack.

In addition, specific mechanical properties and specific electrical properties, moldability and economy of manufacture and maintenance were vital considerations in the use of plastics.

Molding compounds used by the Bell Telephone Co. range from the plain woodflour phenolics to the various thermoplastics, depending on the application. The company has found it advantageous to produce their own dies—conventional boring, milling and hobbing processes are used. It is reported that very little success has been had with the other methods, such as casting with hard alloys.

The dies used are of 3 general types: the open or flash die, the closed or positive die, and the injection die. Shellac-mica commutators (Fig. 6) are manufactured by means of a flash die. A typical telephone part made in a semi-positive mold is the handset handle shown in Fig. 3. More delicate inserts are injection molded. Since the material is enclosed in an auxiliary pressure chamber and is not exposed to the atmosphere, greater freedom from room dust is possible, rendering this method ideal for colored plastics. A terminal block used to terminate the subscriber's telephone cord is made from thermoplastic molded cellulose acetate compounds as shown in Fig. 7.

Finishing and trimming methods are largely determined by the design and class of service required of a molded part. In the case of the injection molded cellulose acetate terminal block, the gates are trimmed by a simple trimming punch and the scrap is reused.

The telephone handset must be carefully finished to avoid roughness and to present a good appearance, since it is literally in the hands of the public. The handset handle was originally ground along the fin left by the semi-positive mold and then buffed. The operation was not only expensive but tended to grind off a large portion of the surface of the handle. This removed the resin-rich surface and tended to expose the filler of the phenol plastic molding compound, thus reducing the appearance life of the handle. The more recent product of the Bell System is being grooved along the die parting line. This removes the fin, a minimum of resin-rich surface and does not detract from the appearance of the handset. Automatic grooving machines were developed for this purpose.

It has been found necessary by the company to pay close attention to the design in order that die parting lines, ejector pin marks, gate marks and the like will appear at points where they may be readily eliminated by simple trimming and grooving operations, or where they may be left without objection to appearance or function of the part.

Although the most satisfactory test that can be applied to telephone parts on completion is service, the ideal is seldom realized not only because of the difficulty of defining the service requirements but of finding tests that are wholly representative of service conditions. It is customary, therefore, with the Bell Telephone Co., to apply a series of tests whose sum total will approach the ideal as nearly as practicable. Molded organic plastics are different from parts made from most other materials in that the molding process may modify them and render them quite different from the raw material. In the case of thermosetting compounds this is particularly true.

Tests are in the main applied to a molded part of a representative specimen of the fabricated material. In the telephone plant the items that are of most importance are strength, both transverse and impact, permanence of form, appearance, effect of moisture and drying on swelling and shrinkage, insulation resistance, electrical breakdown potential, and reaction on adjacent materials.

According to the Bell Telephone Laboratories, there is no known test that will completely measure the quality of a phenolic plastic part. Therefore, it is necessary to resort to the expedient of testing standard bars molded under specified conditions. Five bars are molded in a positive type die, the step arrangement providing for flow within the die (*Please turn to page 112*)

High voltage instrument resistors

by U. L. SMITH*

Plastics perfect answer for electrical applications from standpoint of accuracy, atmospheric conditions and molding

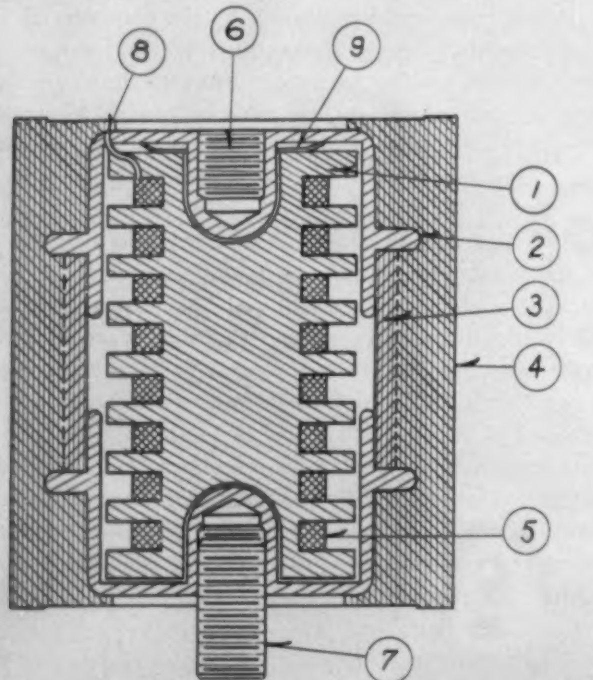
As dimensions go .0015 of an inch is not small, but a wire this size, and more than half a mile long, with 1000 volts across its ends, is a comparatively delicate thing. Instrument resistors of the precision type are wire wound with these conditions, and adequate protection of such wire has been a major problem.

From plastics was chosen the material that afforded the best electrical, chemical and mechanical protection, combined with its ability to be molded into desirable shapes. A good electrical resistor of the $^1/_2$ percent class has to maintain its accuracy not only through adverse atmospheric conditions but over years of service. Protective coatings such as waxes or varnishes applied directly to the wire, were found to be either ineffective against the action of salt water and other corrosive influences, or they were injurious to the wire itself. The solution seemed to be, not to protect the wire direct but to seal the complete resistor spool inside a housing. This is shown in Fig. 1. The resistor unit is completely free, except for the supports at the end of the spool. There is no coating applied to the wire, and the whole spool is hermetically sealed by the outside shell of plastic. This leaves the wire surrounded by air which is a better dielectric insulator than any of the waxes or impregnating compounds.

The construction as shown in Fig. 1 is the ceramic spool (1) and the resistor wire (5). The two brass caps (2) that fit over the ends of the spool serve as terminals and also as carona shields, to protect the wire on high voltages. The leads from the resistor are soldered to the terminal at (8). A laminated plastic paper base tube (3) fits between the brass terminals and prevents the plastic flowing around the wire during the molding. It was found that after molding, the tubing and plastic were bonded together so firmly that when a section was made the line of separation could not be seen with the eye. The plastic (4) is applied by transfer molding. The two brass end caps are held firmly in the ends of the mold during the molding, so as to insure a definite spacing between the ends of the finished resistor. Considerable care has to be exercised in molding both in the consistency and the amount of the material. Too large a charge builds up enough pressure to break through the laminated tubing and allows the plastic to flow around the wire. Too small an amount of material leaves a rough porous surface. (*Please turn to page 108*)

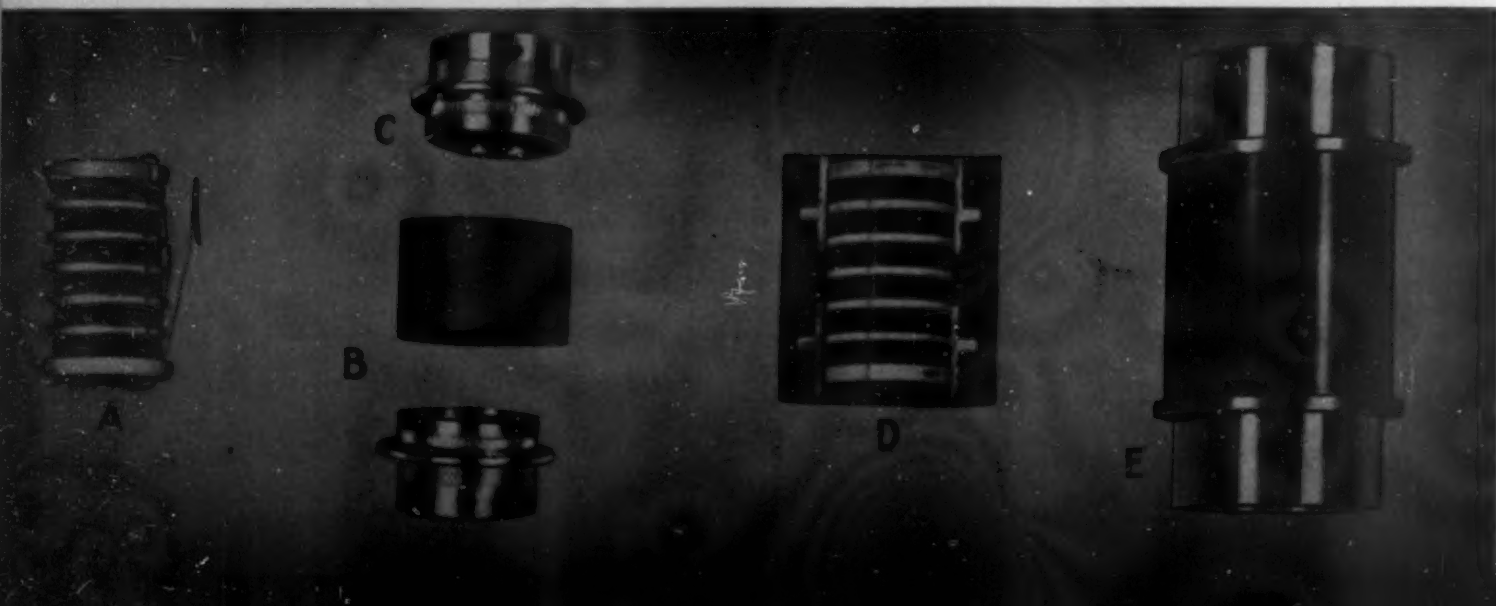
* Instrument Engineer, Meter Division, Westinghouse Electric and Mfg. Co.

Fig. 1



1—Here is a graphic illustration showing a cross section of the sectional resistor with construction details. 2—Detailed construction features of sectional resistors are shown by these separate parts. They are the following, (A) Wire wound sectionalized ceramic spool. (B) Part of molded case. (C) Nickel-plated brass cup with 10–31 female thread. (D) Molded assembly and (E) Complete section showing nickel-plated brass ferrule ends

2



Wm. T. Cruse

September 13, 1941

Dear Charlie:

It is with a feeling of regret that I relinquish the Editorship of Modern Plastics. It has been eminently gratifying to serve the Plastics Industry in this capacity. Moreover the actual performance of the duties have been genuinely pleasant. I have appreciated the association of a highly competent and most agreeable staff. I shall always be grateful to them for the cooperation they extended.

An editor's relationship to his industry is an unusual one. It rests upon the cornerstones of reciprocal confidence and the furtherance of a common interest. As Editor I have enjoyed and endeavored to express every manifestation of this relationship.

That these are troubled days we all know only too well. Predetermined plans which have been made to fit the pattern of a peaceful scheme must be remade and readjusted to fit changing conditions. Certainly personal considerations must be subservient.

The Board of Directors of the Society of the Plastics Industry feel that my specialized knowledge of the industry is what they require to administer the organization's affairs. Therefore, they have asked me to assume the office of executive secretary. I have accepted. In doing so I am not unmindful of the dislocation this imposes upon the paper and you but I am sure that as usual you will ably cope with the situation.

In this new undertaking we still continue to have a common objective, the furtherance of the plastic industry and toward that end I hope you and the Modern Plastics' staff will call on me often.

Sincerely,

Bill

W. T. Cruse

Mr. Charles A. Breskin
Breskin Publishing Corp.
122 East 42nd Street
New York City

WILLIAM T. CRUSE

Charles A. Breskin
CHANIN BUILDING
122 E. 42nd ST. NEW YORK, N. Y.

My dear Bill:

It is a matter of deep regret to have to accept your resignation as the Editor of Modern Plastics, but since yours is a call from the industry, I have no alternative. Our position, as you well know, has always been to serve the industry regardless of personal circumstances.

In selecting you, the industry has chosen the one man who in my estimation can weld it into an executive unit which will adequately represent all of its interestsin Washington and elsewhere.

All of us will miss our pleasant relationship with you, but this will be tempered by the fact that we will be close by, and that in your capacity as Executive Director of the Society of the Plastics Industry, we still can work together toward a common goal.

And in your new capacity, the cooperation of Modern Plastics and its staff will always be extended to you.

My every good wish for your continued success and happiness.

Mr. William T. Cruse
25 Fifth Avenue
New York City

Sincerely,

Charles

C. A. Breskin

Hail and Farewell

Goodbye is never much fun to say, and this is no exception to the rule. We have worked with you so closely that we are most keenly aware of our loss. You have not only been a good editor—as an editorial staff recognizes and appreciates an editor—but you have been fun to work with, sympathetic and tireless in your efforts to make MODERN PLASTICS the type of magazine we all want it to be. SPI will profit by your leadership and we join with our publisher in wishing you good luck!

The Staff

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PLASTICS IN REVIEW

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1 Sister goes back to school to find a better pencil sharpener due to a re-design job on the "Everhandy" in which die cast metal has been changed to cellulose acetate butyrate for strength, looks, and low cost. Reinforcing ribs are molded in. Molded bosses used for ease of assembly. Molded of Tenite II by National Organ Supply Company

2 The new Firestone Air Chief portable radio is compact and lightweight, but it's big enough to give wide reception and sturdy enough to do a lot of traveling. Lustron is used for case cover which contains a built-in aerial. Molded by Superior Plastics Company

3 Grandpa never saw spectacle cases which looked like this or, for that matter, could be purchased as cheaply. They are made of cellulose acetate, another example of plastics replacing aluminum, and injection molded by Bachmann Bros. Plastic made from Hercules flake

4 Translucent Beetle has been put to good use in this new molded lamp. It diffuses light from the bare bulb in a soft, glareless illumination. The material eliminates the necessity for stamped metal reflectors usually associated with this style lamp. It is extremely light in weight, modern and attractive in appearance. Molded by General Products Corp., for Sani Products Mfg. Company

5 Important parts of the gas mask used in United States military training are the intake valve guard

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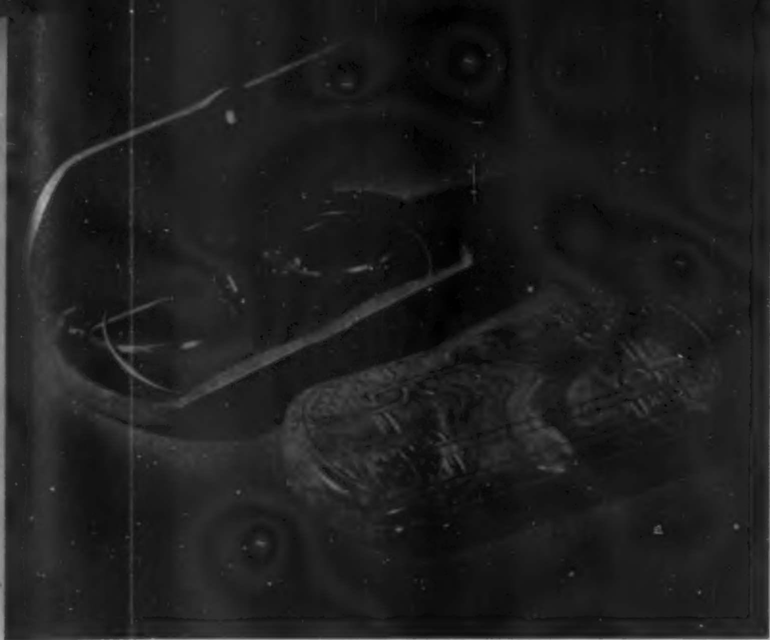

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and eyepieces, both molded from non-fogging Lumarith especially developed for this application. Valve guards are from Mack Molding Co. and from Franklin Plastics and Die Casting Div., Baldwin Labs. Eyepieces from Allied Plastics Corporation

6 Streamlined kitchens take another step forward with extruded strips of Tenite in continuous lengths made by R. D. Werner Co., Inc. They replace metal strips for sink and shelf edgings in this modern kitchen installation by Lakeville Mfg. Company

7 Although necessity prompted switch from cast aluminum to molded phenolics for this fan blade, plastics have proved more satisfactory for the following reasons: lower cost; light weight which lessens motor strain; smooth and well-balanced, imparting little noise to air stream. Molded of Bakelite by Auburn Button Works, Inc., for Northwest Air Circulator Fans of Grainger, Inc.

8 Prettiest craft on any body of water this year was undoubtedly this rowboat made entirely of crystal-clear Lucite. Fine for observing marine life from bottom of the boat. Originally designed for store display by Clemens Scheuer, it was found to have outdoor possibilities

9 A smart beauty shop dispensing devise used to handle liquid shampoo and wave set solutions has a three-piece ivory molded Beetle housing. It replaces 7 sheet metal case parts and one glass container and makes possible a 66 percent reduction in weight and 45 percent drop in cost. Designed by Howard C. Mitchell for Ariston, Inc., Specialty Insulation Mfg. Co., molder

10 Maintenance care on this dispenser cabinet of Plaskon is reduced to a minimum for stains and smudges, easily removed with a damp cloth. Top is slanted to discourage placing of lighted cigarets. The tissues, which are impregnated with scented soap, turn into individual pieces of soap upon immersion in water. Molder: Chicago Molded Products for Velso Products Company

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11 Time, speed and distance are reported in graphic form by this Tachograph. It gives a precise accounting of the number of times engine stopped and started, changes in speed, and warns driver when he exceeds speed limit. Made by the Sangamo Electric Co. and distributed by Wagner Electric Corp. Shock-resistant housing molded of Bakelite

12 Gold and silver plate Celluloid frames enhance the beauty of these formal (and expensive!) evening bags. Underarm bag is of hand-gathered lamé braid framed on both sides with hand carved, gold plated cellulose nitrate (about $90), as is the crown top of the antelope pouch bag in foreground (about $85). Frames by Simplex Button Co. for de Calsta Co.

13 Simplified and silent timing device is incorporated in this new automatic toaster by General Electric Co. Entirely new in appearance and design, it has a decorative molded Textolite base brought up high on sides to form part of outside structure. Heat-resistant and washable, the plastic base is available in black, mottled brown or cream. Handles and knobs are of the same material

14 Aid to airmen is an oil gage made by General Electric with a lightweight Crystalite lens which is light, shatterproof and shockproof. It consists of a double lens, one sealed inside of the other for easy removal of the outer lens without disturbing the mechanism sealed by the inner lens

15 This transparent Lucite dispenser issues a special chemical test paper of 11 different color changes, depending upon the acidity or alkalinity of the solution in which it is placed. Molded in 2 parts by Injection Molding Corp., for Micro Essential Laboratories. Clear case permits chart of the papers to be enclosed and legible from the outside

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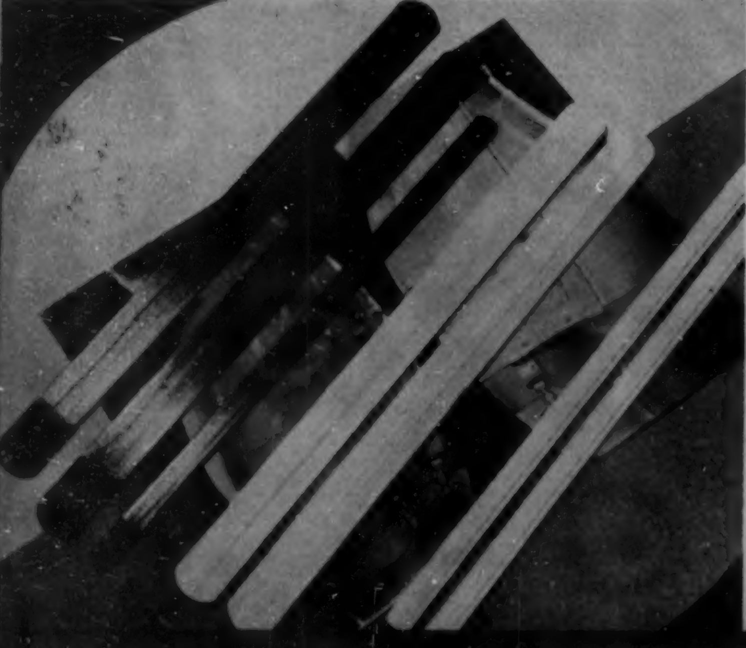

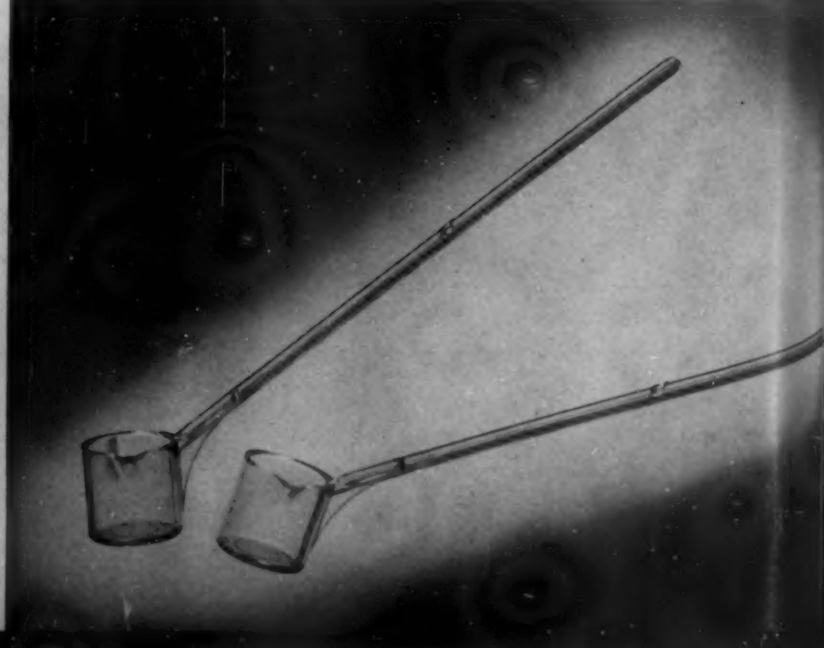

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PLASTICS IN REVIEW

16 Madame owes the comfort of her corset stays to plastics as well as steel. After steel is cut in desired lengths, the ends are sealed by dipping them into a Celluloid solution. Process wraps, cements and seals in one operation. Steels from Wallstein Industrial Corporation

17 Polystyrene dippers replace glass, metal and steel for the Babcock butter fat tests. These are used in all dairies to attain accurately measured samples of cream. Molded of Lustron by Elmer E. Mills Corporation for American Butter Institute

18 Handsome Jewelite dressing table set makes an ideal gift for any time of the year. The mirror has a genuine beveled plate glass on both sides. Molded of Crystalite by Pro-phy-lac-tic Brush Co.

19 Add glamor to your Christmas tree this year with the new cellulose acetate ornaments to replace imported glass balls. They are molded by a special process that minimizes finishing labor. Molded by Plax Corp., of Hercules cellulose acetate, for Taylor-Freeman-Stanley, Inc.

20 Described as "a mite in the hand, but mighty in performance," this handsome Sonora portable radio has three plastic parts—cabinet-housing, back cover and front cover. Front cover is injection molded of gray Tenite. Other parts are of black Durez, molded by Plano Molding Co. and Anfinsen Plastic Mold Company

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Processing pyroxylin sheet stock

By J. H. DeSobe[1] and Mark Peters[2]

AT the turn of the century the most outstanding application of celluloid in the mind of the public was the Celluloid collar, good for a laugh on any vaudeville stage. Today, however, its applications are so many and varied that even the most uninquiring mind is aware that it owes many of today's conveniences to the modern sheet plastic.

It is estimated that cellulose nitrate sheet is used for over 25,000 separate and individual applications, and in each of these separate classifications there are thousands of other related uses.

Among the applications very much in the public eye are identification badges worn by employees in plants engaged in defense work; typewriter key faces, radio dials, automobile clock and speedometer dials, aircraft plotters, plastic shelf markers, nail polish color selectors, calculators and washable playing cards.

The basis of modern sheet plastic is, of course, the same as it was in 1872, namely, cotton sulphuric acid and nitric acid. The material obtained by the combined action of nitrate and sulphuric acids on cotton is nitrocellulose. By adding nitrogen, a high explosive can be obtained, but the material we are familiar with on calendar cards, and rules, blotter tops, etc., is of very low nitrogen content. Cellulose nitrate sheet was first used in a practical manner to take the place of rubber for dental plates. From that time on, it was produced in sheet form for thousands of other items. In fact, production in fabricated sheet stock has been so rapid that it would be impossible to discuss all of its uses in this article. We will attempt, however, to give an outline of today's manufacturing procedure on sheet plastic and to illustrate and describe a few of the more unusual uses of fabricated sheet stock.

Cellulose nitrate sheet can be obtained in any color of the rainbow as well as transparent. It can be printed in any number of colors including four-color process work on sheet plastic. It can be dyed or cut to any shape and under heat and pressure the sheets can be formed into any particular shape required. The most recent development in sheet plastic is a cloisonné process on sheet stock. This revolutionary process brings back the beauty of cloisonné metal in color and design comparable to that produced by the expert metal craftsmen of another era. This will be discussed below in the process of fabricating cellulose nitrate sheet.

Fabrication process

1. *Sheet stock:* Sheet plastic is produced in sheets measuring 20 in. by 50 in. It is also available in rolled stock to any width desired in certain thicknesses.

2. *Materials:* For many years, a large portion of sheet plastic has been produced in acetate stock which is slow burning or non-inflammable. Many people think of cellulose nitrate sheet as an explosive. Actually, it is not more explosive than a piece of paper, but it will burn much faster than cardboard or paper in nitrate form. As proof that it is not considered dangerous, the postal authorities permit the mailing of nitrate cellulose calendar cards, rules and other specialties in all postal cars. Acetates, on the other hand, if ignited will burn very slowly or not at all, depending upon the amount of plasticizer in the material.

3. *Cutting:* Sheet stock is cut on a power cutter, to any size that may be required for the particular job. Large jobs, as a rule, are printed on half-sized sheets. Smaller jobs are cut to whatever size press for which they are scheduled as required.

[1] Manager Fabricating Division, Cruver Mfg. Co.
[2] Nixon Nitration Works.

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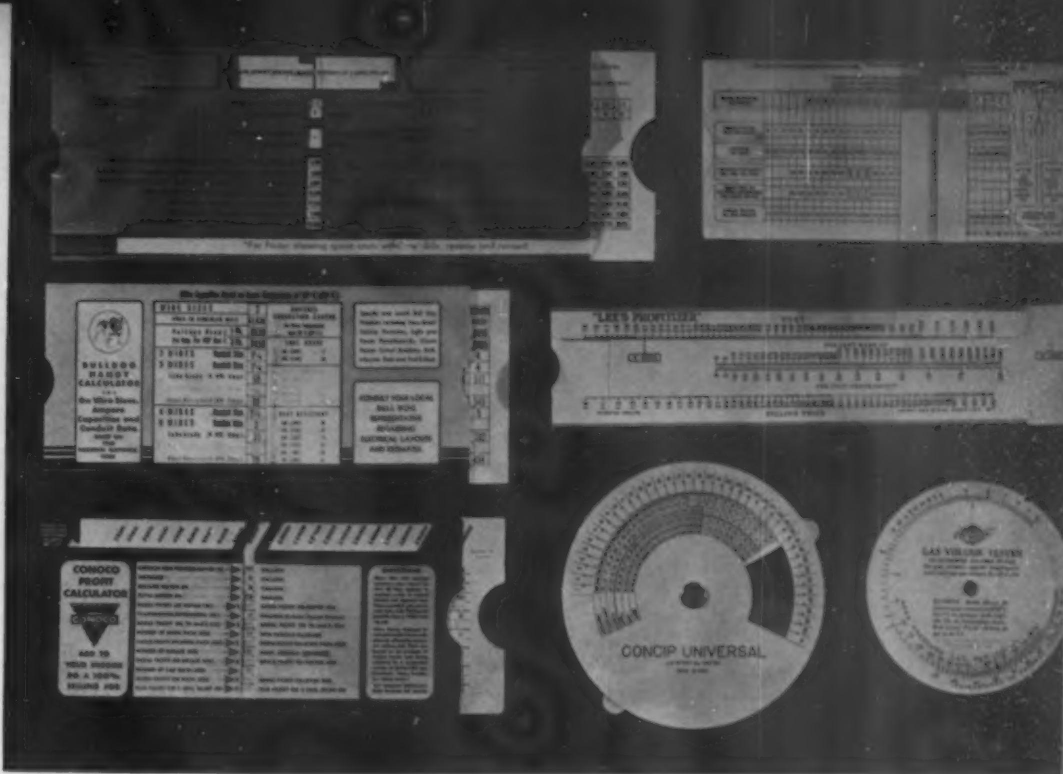
1—Cellulose nitrate sheet stock printed and fabricated from .030 and .060 thickness is used on dashboards of some new cars. The speedometer dial is made of sheet plastic in color to harmonize with the interior. 2—The familiar identification badge in these days of national defense is made with a non-inflammable plastic material window. Also has a special clinch rim and patented double catch pinlock

3—Typical examples of individual applications of the modern sheet plastic for various types of calculators. 4—In the field of Aeronautics, the material insures absolute accuracy by careful printing on a well seasoned plastic. These are examples of flight computers that are widely used today. 5—The layout artist finds this gadget light and easy to handle on the drawing board



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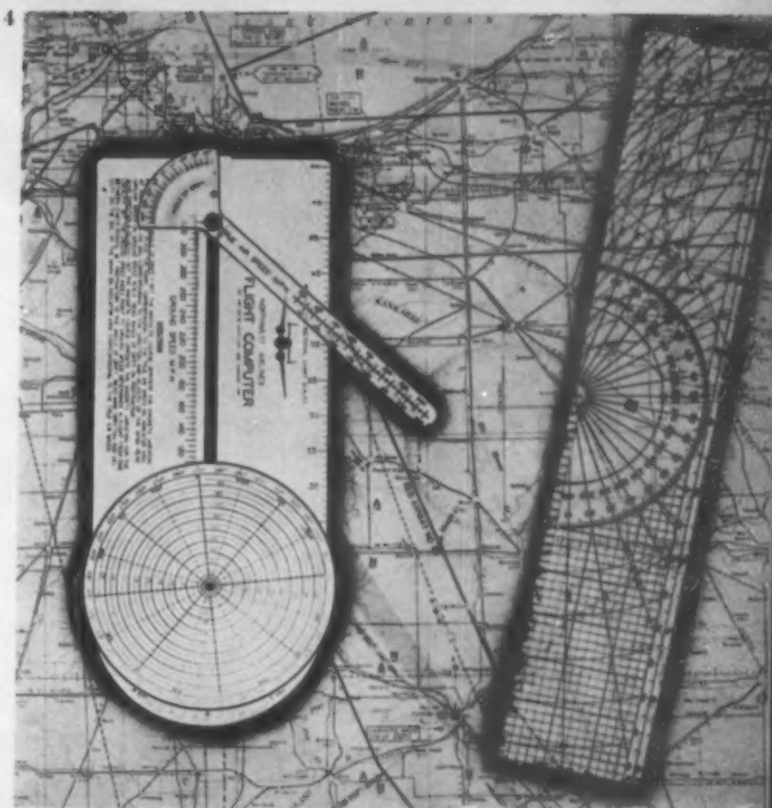

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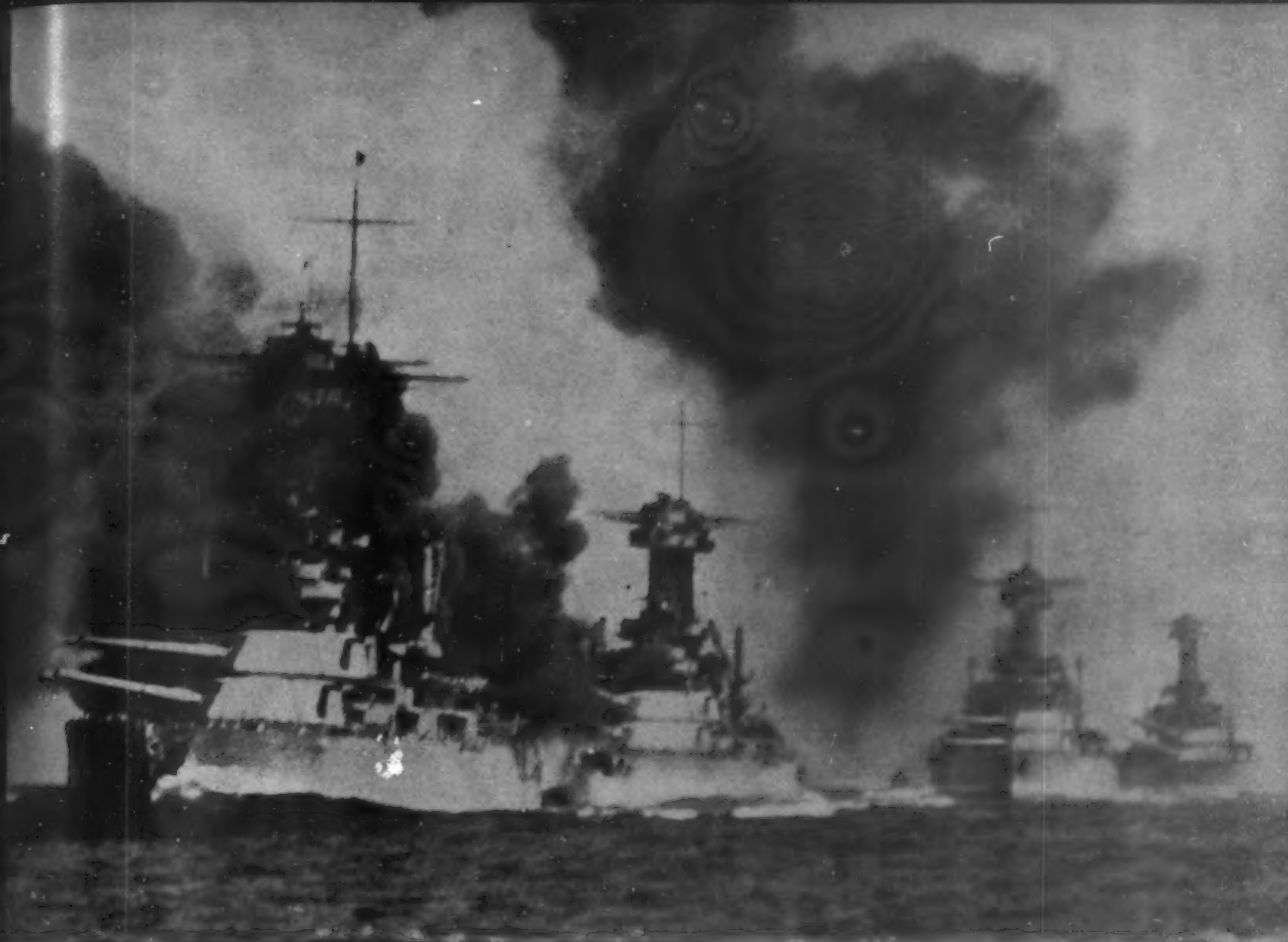
4. *Printing on sheet:* Fabricating plastic is an art in itself. Printing on it can be compared to printing on glass. As an illustration of the care required in printing on sheet plastic, a good example is to compare paper and nitrate sheet printing. An average job on a paper printing press will run about 3000 impressions per hour. Printing on sheet plastic means slowing the press down to 800 per hour, and many times during the run, adjustments have to be made for the variation in thickness that occurs on each sheet. There are no limitations to printing on plastics. Four-color process, as well as offset work can be run just as easily as a one-color type set job. The only difference between printing on paper and cellulose nitrate is in the beauty of the finished pieces. The high polish which occurs later in the process brings out the beauty in colorful set-ups and actually magnifies fine lettering.

5. *Polishing:* One of the most important factors in producing a beautiful job of printing is the polishing operation. After the printing is thoroughly dried and well seasoned, the sheet plastic is placed between highly polished chrome plates and under tremendous heat and pressure, the surface is melted and then quickly chilled by running cold water through the steam pipes. The result is equivalent to a glossy finish on a photograph and the sheet plastic is peeled from the plate just as a photograph is taken from the polishing plate. A beautiful job of printing can be made or broken in the operation of polishing. The timing and the amount of pressure and heat is a major factor and skill is required.

6. *Forming:* By careful determination of heating and pressure application, sheet plastic can be formed into deep draws; even printed designs can be drawn without distortion by careful engineering before printing. Clear plastics, as well as opaque colored and printed plastic, are all drawn into various shapes and designs by highly polished thermostatically controlled heating chrome plated dies. (*Please turn to page 116*)



Acme Photo

These non-shattering battleship lampshades of Molded Plaskon are molded by the Plastics Division of General Electric Company, Pittsfield Mass., for the Lovell-Dressel Company, Arlington, New Jersey.

Stock molds

SHEET ONE HUNDRED-TWELVE

Cosmetic containers—decorative powder or rouge boxes, talcum shakers—shaving brush stands and utility cups are excellent for packaging and premium use. Available from stock molds without mold cost. Address Modern Plastics, Chanin Building, New York, giving item and sheet numbers

1353. Circular box, overall height 1 3/4 in. Separate cover 3 in. in diameter. 1 1/4 in. deep; 2 3/8 in. diameter of bottom. Raised semicircular handle molded onto cover

1354. Cosmetic box 2 7/16 in. diameter; 1/4 in. deep; threaded cover. Good for powder, makeup foundation or cleansing pads

1355. Two-piece 1/4 oz. cosmetic container; 1 5/8 in. diameter at bottom; 3/16 in. deep; decorative threaded cover

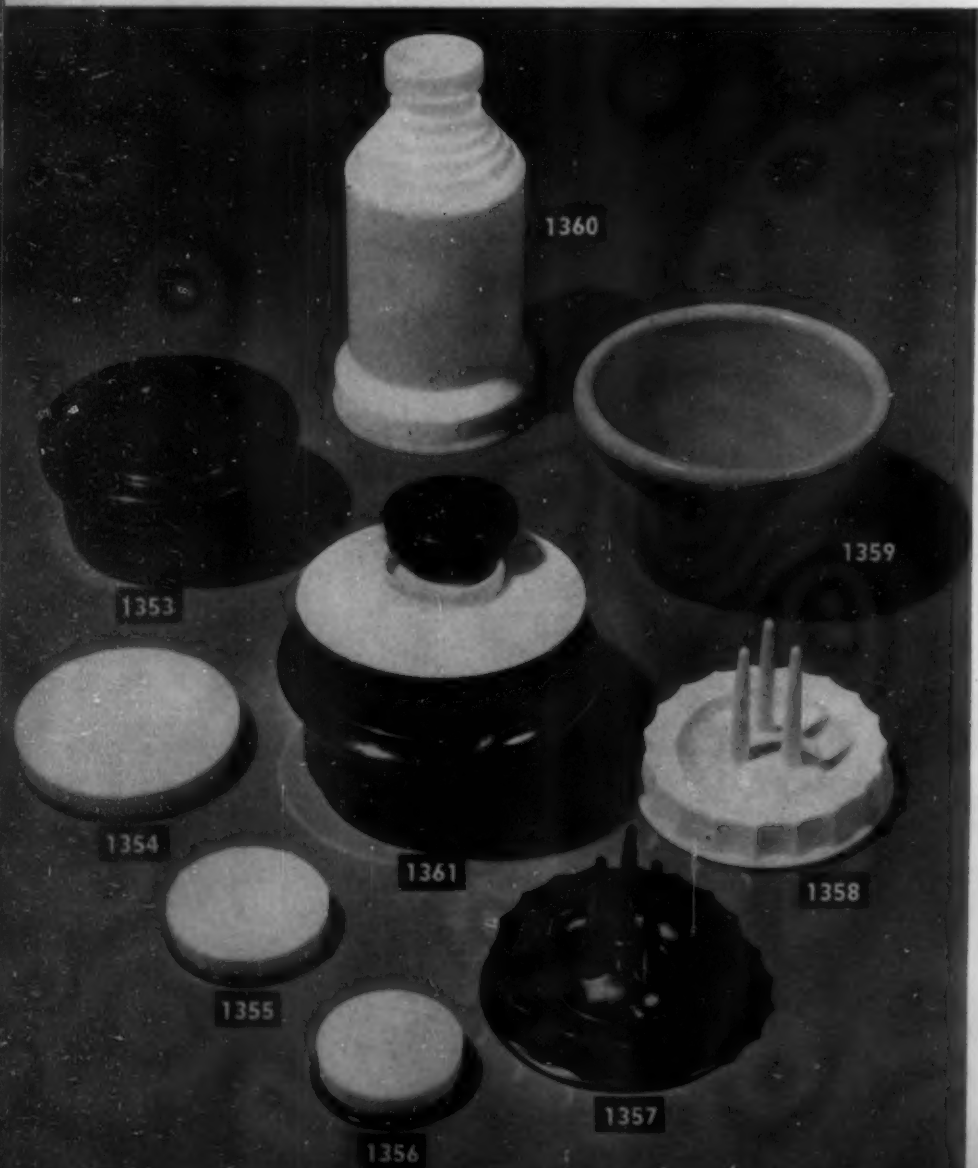
1356. Two-part cosmetic container, 1 7/16 in. diameter at base; 3/16 in. deep. Indented rectangular area in center of cover

1357–58. Shaving brush stand 2 3/4 in. diameter; prongs 1 1/2 in. high. Fluted sides; bristled end of brush is placed on prongs and excess water drips into saucer base

1359. Utility cup 3 1/2 in. diameter at top; 2 in. diameter of base; 2 1/2 in. deep. Overlapping edge

1360. Powder shaker with perforated top; 4 1/4 in. overall height; 2 1/2 in. diameter base which is threaded to be removed for refilling. Center section, 2 in. in diameter. Decorated threaded cap 1 1/8 in. diameter. Capacity, 4 oz. Container pyramided towards top. Available in solid and two-tone colors

1361. Three-part container; overall diameter at top 3 3/8 in.; 2 13/16 in. diameter at base; 1 1/4 in. deep. Has four 1/4 in. legs for support. Cover has 3 in. diameter; rouge container on top 1 3/8 in. diameter



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All molders are invited to send samples from stock molds to appear on this page as space permits

Technical Section

DR. GORDON M. KLINE, Technical Editor

Creep and cold flow of plastics

By J. Delmonte* and W. Dewar*

INCREASING use of plastics and resin-bonded plywoods for structural applications has created a demand for further information on creep properties of plastic materials. Test methods have been developed for measuring creep, using a one-half inch cube of the material placed under compressive stress for 24 hours at 120 deg. F.[1,2] While useful comparative results are obtained, a possible objection may be the thickness of the test specimen which is not always representative of the plastics as produced in sheet or molded form. In their applied form they are generally of thinner dimensions. Under compression test of this nature, the relatively small amount of creep experienced for stiff, rigid materials increases chances of error.

For the tests described herein creep measurements were conducted upon simple cantilever beam specimens. Similar tests upon plastics were conducted earlier by one of the writers.[3] Determination of creep by beam deflection methods is also well known for metals.[4] One advantage of beam deflection methods is the greater ease of observing creep, because the magnitude of the changes which occur is greater than in pure tension. Further, the physical properties of plastics are dependent upon the methods of manufacture and hence, it is desirable to use commercial grades and thicknesses as simple beams rather than thicker non-standard pieces. While constant fiber stress is not developed on the specimens during test, the shear diagram for a simple cantilever beam with a constant weight at one end is quite uniform, and creep characteristics of both compression and tension are observed simultaneously under conditions approximating those in structural uses.

Specific aims of this investigation were as follows:

1. Determination of creep as a function of the time of application of the load at constant temperature and constant load, and recovery upon removal of the load.
2. Determination of the effect of temperature upon creep of representative samples of plastics.
3. Development of a short time test to determine rapidly the magnitude of creep which may be expected in a plastic material.

Materials investigated

The following materials were employed in conducting these tests:

1. Laminated phenolic, paper base, grade XX sheet (.063 in. thick).
2. Polymethyl methacrylate, clear (.057 in. thick).
3. Cellulose nitrate, white standard (.064 in. thick).
4. Cellulose acetate-butyrate sheet (.063 in. thick).
5. Polyvinyl chloride-acetate sheet (.057 in. thick).
6. Polystyrene, injection molded bar (.062 in. thick).

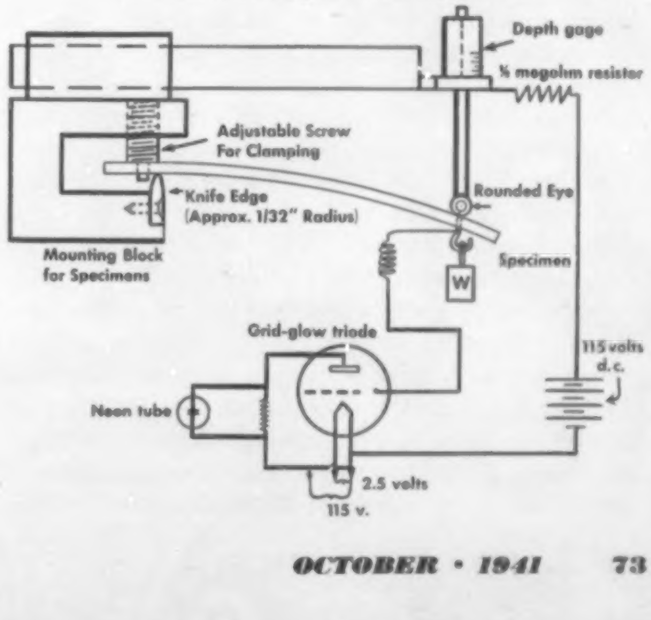
With the exception of the polystyrene, all samples used for tests were prepared accurately to .500 in. width, and a test length of exactly 6 in., plus overhang for insertion in test equipment. The polystyrene test length measured 2.5 in. and a width of .250 inch. Prior to test, samples were conditioned for 24 hours at 50 deg. C. and to maintain constant moisture content during the long tests, samples were lightly coated with paraffin wax after the conditioning treatment. Earlier tests by Penning and Meyer showed the dependence of creep upon the moisture content of the samples.[3] They reported an increase in the amount of creep with increased humidity used in conditioning the samples.

In addition to the above materials, samples of birch and poplar veneers were laminated together, and creep tests conducted upon these materials. These samples were not conditioned. Four-ply veneers were prepared. The direction of fibers was alternated in adjacent plies.

Test method

A schematic outline of the test equipment appears in Fig. 1. Specimens were cut to the size noted above, conditioned at 50 deg. C. for 24 hours, and then mounted on the test block illustrated in Fig. 1. The test length

1—Schematic diagram of test apparatus



* Plastics Industries Technical Institute, Los Angeles.
† This paper was presented at the Annual Meeting of the American Society for Testing Materials in Chicago, Ill., on June 24, 1941, and is published here by permission of that society.

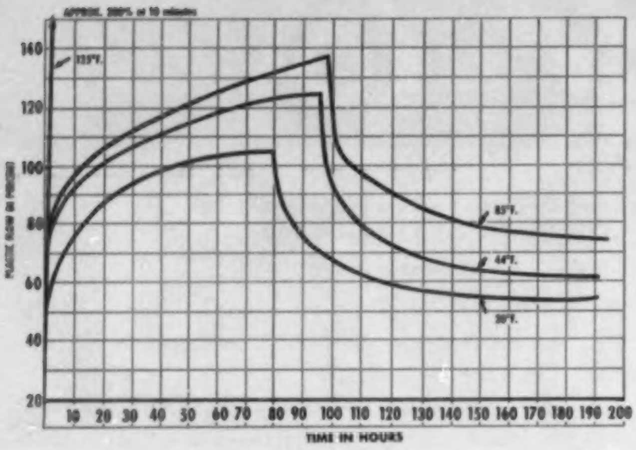


Fig. 2

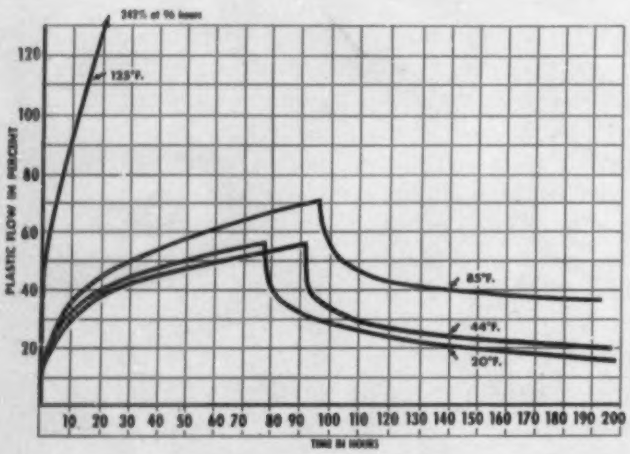


Fig. 3

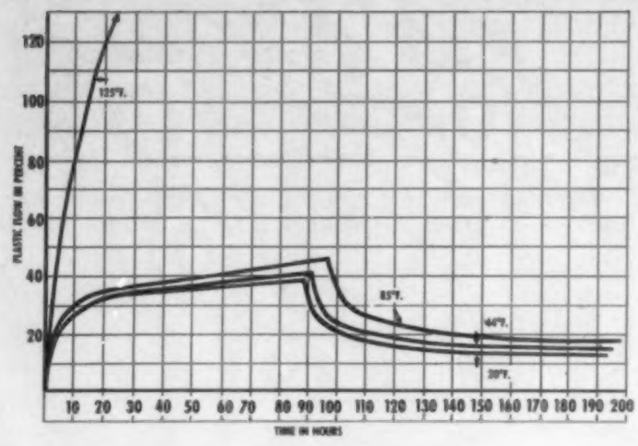


Fig. 4

2—Time-deformation properties of cellulose acetate butyrate of 0.064 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. in. 3—Time-deformation properties of cellulose nitrate of 0.063 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. in. 4—Time-deformation properties of polymethyl methacrylate of 0.056 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. inch

of 6 in. was measured from the center line of the knife edge to the center line of the rounded eye, which was formed integrally with a suspension hook for weights. The weights were hung directly below the rounded eye contact member. On fastening specimens to the mounting block, it was felt that rather than rely upon a screw clamping plate, it was better to use an adjustable screw (pitch diameter—$^1/_2$ in.) for clamping (see Fig. 1). In accomplishing this, the screw was finished flat across its end and left with a projection $^1/_8$ in. in diameter and $^3/_{16}$ in. long. The boss mated with a hole drilled directly in the test specimen. The screw was tightened down until the specimen was perfectly level. In this manner a control was exercised upon the degree of clamping. The centerpoint of the adjustable screw was exactly on the center line of the knife edge.

The mounting block was provided with 12 spaces for mounting specimens. The measurements were made with the aid of a depth gage reading to .001 in. and provided with a 3.5-in. stroke. This gage was movable upon a precision block forming part of the mounting block for specimens. It was possible to adjust the gage parallel as well as perpendicularly, with respect to the center line of the test specimens. Rather than rely upon visual observations for the establishment of contact of the depth gage upon the rounded eye, which was formed integrally with the suspension hook, the eye was connected electrically with a fine wire of negligible weight in the grid circuit of a grid-glow control tube (No. 885 gas-filled triode). At the completion of the contact, the grid assumed control of electron flow in the tube and the neon light that was connected in the plate circuit went out. The gage was then slowly raised to that point just where the contact was broken and the neon light appeared once again. The depth gage was then read with the aid of a magnifying glass. After a little practice, readings could be reproduced within plus or minus .001 inch.

In conducting these tests, particularly when thin specimens are used, every factor contributing to the weight at the end of the beam must be closely watched. For this reason, dial gages were not employed in measuring deflection because the weight of the spring mounted plunger was excessive in so far as these test measurements were concerned.

Another modification of the above apparatus used in these tests is referred to in this paper as a spark test apparatus. Specimens were mounted in position with the aid of a clamping plate, and calculated weights hung on the end to develop fiber stresses, as explained later. However, instead of relying upon a depth gage to make the deflection measurements, a spark was jumped from a point mounted upon the end of the specimen to a nearby chart mounted parallel to the plane of deflection of beam. The big advantage of this method lay in the fact that deflection measurements after weights were hung could be obtained almost instantaneously, without the delay usually attendant upon adjustment

of the depth gage for a reading. Deflections were measured at the conclusion of the test with the aid of a pair of dividers. Deflection points were punctured on the graph paper by a high voltage supplied from an induction coil. When it was desired to make a reading, a contact was momentarily closed and a spark allowed to jump across the gap, puncturing a hole in the test paper. However, measurements with spark test equipment were not made with the same degree of precision as with the other equipment, having a reproducibility of only plus or minus .005 inch depending upon how accurately points on the chart could be read.

Developing Fiber Stress.—Weights were calculated for developing fiber stresses of 1000 lbs. per sq. in. in most tests from the well-known formula

$$M = SI/c$$

where M, the maximum bending moment, equals weight $\times$ beam length,
S is the maximum fiber stress in lbs. per sq. in.,
I is the moment of inertia,
and c is the distance from neutral axis to outermost fiber.

Thus, for example in the above formula there would be substituted 1000 for S and values for I and c as determined by the physical constants of the test specimen, and the required weight would be calculated. In most tests between 25 and 30 gm. was the total weight at the end of the beam, including the rounded eye and hook for attachment of the weight. Corrections for the distributed weight of the test specimen itself would bring the total fiber stress up to 1050 to 1100 lbs. per sq. in. In applying the above formula, the validity of Hooke's Law is assumed for the instantaneous deflection immediately following the application of the load. However, because of creep even at low stresses, deviations could be expected.

Measuring Deflection and Explanation of Terms.—Weights were carefully suspended on the hook at the end of the test specimen by hand, and the stop watch was started the instant the weight was hung. Sixty seconds were allowed to elapse before making the first reading of deflection with the depth gage. This time was ample to adjust gage to position for making an accurate reading. This reading constitutes the Initial Deformation reading and is comprised of two parts: (1) elastic deformation, and (2) creep during the first 60 seconds. In some cases the creep during the first 60 seconds was as high as 10 to 15 percent of the instantaneous elastic deformation. Subsequent deflection at the end of the beam from 60 seconds to several hundred hours in some tests was measured and constitutes Plastic Deformation.

Plastic deformation exhibits two stages, one in which the rate of plastic deformation is continuously changing, and the other in which the rate of plastic deformation is substantially constant. Where the rate is changing, deformation phenomena are referred to as *creep* and where the rate is constant, deformation is referred to as *cold flow*. As an example, in Fig. 4 for polymethyl methacrylate at test temperatures of 20 deg. F. to 85 deg. F. after 25 hours of applied load, deformation rate falls to a constant value which continues indefinitely. The deformation *after* 25 hours for this resin would be referred to as cold flow, and before this time, as creep.

Measuring Recovery.—After the load was applied for the specified time, which is indicated upon all of the graphs, the recovery phenomena were observed for an equivalent period of time. Once again it was necessary to allow 60 seconds to elapse before adjustments could be made to take a reading with the depth gage. The Initial Recovery reading equals elastic recovery plus creep for 60 seconds. Subsequent recovery at the end of the beam from 60 seconds on constitutes Plastic Recovery.—The difference between the final point observed by the depth gage after recovery has about ceased, and the initial reading prior to the application of the weight constitutes Permanent Set. Thus Permanent Set = (Elastic Deformation + Plastic Deformation) − (Elastic Recovery + Plastic Recovery).

(*Please turn to next page*)

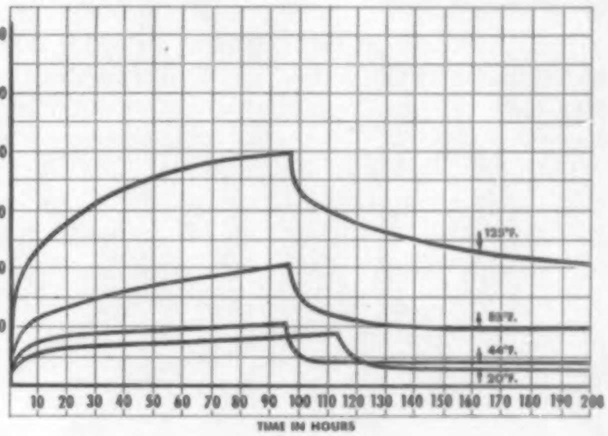


Fig. 5

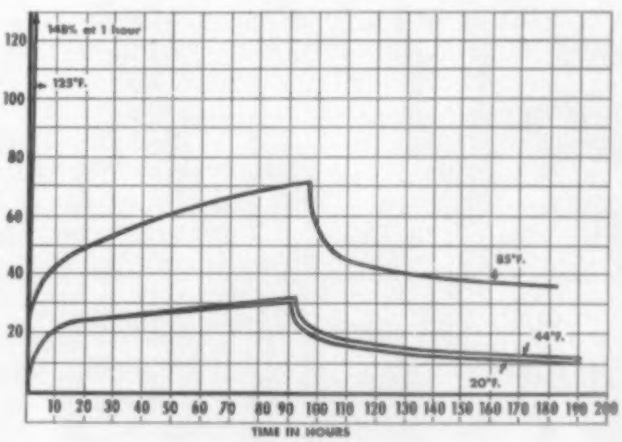
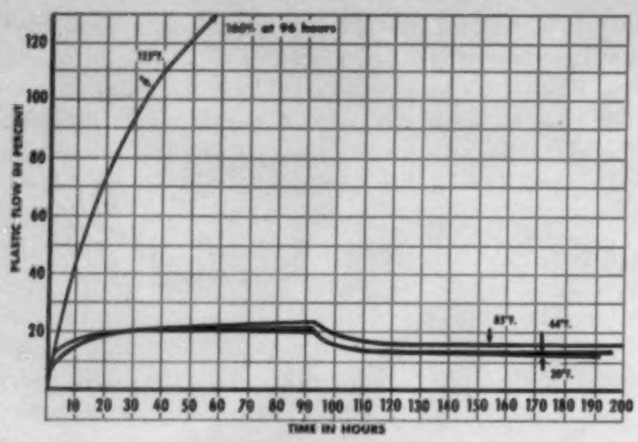


Fig. 6

5—Time-deformation properties of laminated phenolic, grade XX, of 0.063 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. in. 6—Time-deformation properties of polyvinyl chloride-acetate of 0.057 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. inch



7—Time-deformation properties of polystyrene of 0.063 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. inch

In all tests the deformation as measured at the end of 60 seconds was a few percentage higher than recovery measured over same period. This ratio would be exactly unity if only true elastic deformation was involved. This was not the case inasmuch as plastic materials will exhibit creep even at very low values of stress. However, plastics exhibit true elastic behavior during instantaneous deflection under load and recovery from load. Measurements to determine these values are brought out later in this paper.

Plotting of Data.—In Figs. 2 to 7 are reported the time-deformation characteristics of cellulose acetate-butyrate, cellulose nitrate, polymethyl methacrylate, laminated phenolic, polyvinyl chloride-acetate, and polystyrene. The average time for which the load was applied was 96 hours, and the average time that recovery phenomena were observed was 96 hours. Recovery on some specimens was observed for a period about 3 times longer than that for which the load was applied, but further recovery was usually of the order of 1 to 2 percent of that observed during the first 96 hours. The ordinates are plotted as Plastic Flow in percent. This expression is obtained in the following manner:

For deflection while load is applied—

$$\text{Plastic Flow (percent)} = \frac{\begin{array}{c}\text{Total Plastic Deformation after the 60 seconds' reading plus difference}\\ \text{between Initial Deformation Reading and Initial Recovery Reading}\end{array}}{\text{Initial Recovery Reading}} \times 100$$

For recovery after load is removed—

$$\text{Plastic Flow (percent)} = \frac{\text{Total Plastic Recovery after the 60 seconds' reading}}{\text{Initial Recovery Reading}} \times 100$$

Because the initial recovery reading is smaller than the initial deformation reading, a correction is made in plastic flow readings while load is applied for creep occurring during the first 60 sec. by adding a term equal to the difference between initial deformation and initial recovery. By making this correction, the initial deformation is made equal exactly to initial recovery, the condition for true elastic behavior, and plastic deformation and plastic recovery are brought to a common base. Table I illustrates typical values which were measured and calculated.

TABLE I.—DEFORMATION DATA FOR *Polymethyl Methacrylate* SUBJECTED TO A FIBER STRESS OF 1000 LBS. PER SQ. IN. AT 85 DEG. F.

Time	Reading of Depth Gage	Plastic Deformation (Inches)	Plastic Deformation (Corrected)	Plastic Flow (Corrected) as % of Recovery in 60 Seconds
0	.268	.....	....	....
1 minute	1.314	1.046**	0	
30 minutes	1.403	0.089	.138[a]	13.8[a]
1 hour	1.428	0.114	.164	16.5
10 hours	1.525	0.211	.260	26.1
46 hours	1.633	0.319	.368	36.9
97 hours	1.716	0.402	.451	45.4

The load was removed at this time and measurements started immediately on recovery.

		Plastic Recovery (Inches)	
0	Unloaded		
1 minute	.719	.997*	....
30 minutes	.647	.072	7.2
1 hour	.626	.093	9.4
6 hours	.560	.159	15.9
48 hours	.446	.273	27.3
96 hours	.430	.289	29.0

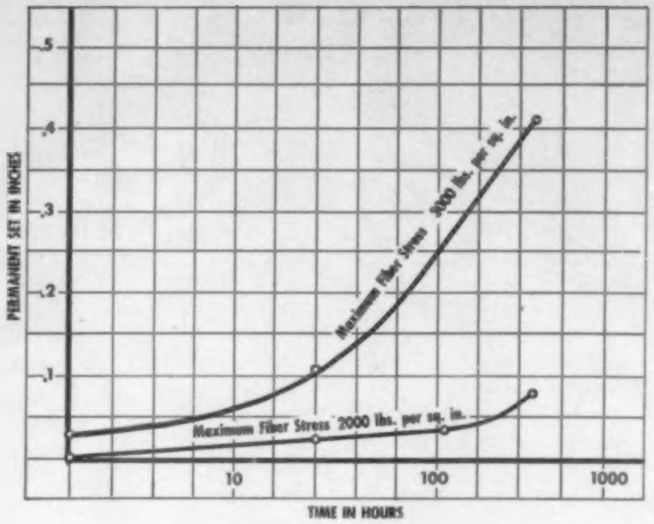
1.046**—60-sec. deformation
.997* —60-sec. recovery

.049 —Correction Factor to be added to Plastic Deformation

Permanent Set: .430 (Final Reading) − .268 (Initial Reading) = .162 in. or 17.0 percent of elastic recovery.

[a] For example .089 + .049 = .138 and .138 ÷ .997 = 13.8 percent.

In plotting the data, to show the effect of creep and recovery more clearly, the initial deflection under load and the initial recovery are left off of the curves and only those phenomena which are unquestionably due to plastic deformation and plastic recovery are included. The most significant facts about all of the curves is not so much the total measured deformation in inches, but the proportion which the plastic deformation constitutes of the initial deformation under load, or, expressed in other words, the ratio of plastic flow to initial deformation, which deformation differs from true elastic deformation by the creep in the first 60 seconds. The



8—Effect of time of application of load at 20 deg. F. on permanent set of grade XX laminated phenolic of 0.064 in. thickness

plotting of data in percentage allows comparisons to be made of beams of slightly different thicknesses, which was the case for the specimens used in these tests.

Temperature.—A few special remarks may be made concerning temperature adjustments in making measurements. Temperatures at which creep was observed were 20 deg. F., 44 deg. F., 85 deg. F. and 125 deg. F. The entire apparatus was placed in a constant temperature container at these respective temperatures, and after the specimens were mounted, enough time was allowed to permit the materials to adjust themselves to the operating temperature. While full data were obtained for deflections at 125 deg. F. on all materials, only small portions of the curves are shown in each case, because it was felt that the error beyond 120 percent plastic flow was quite substantial, inasmuch as the effective beam length had substantially shortened due to the excessive deformation. However, data were obtained which would give some idea of the permanent set under loadings at these temperatures.

Inaccuracies in measurements

Inasmuch as creep was to be determined as a function of temperature, fairly close control was maintained of the temperature. Four ranges were used during the test: (1) 20–22 deg. F., (2) 44–46 deg. F., (3) 84–86 deg. F., and (4) 124–126 deg. F. For higher temperature tests, special temperature-controlled boxes with air circulated by fans were employed.

Considerably greater accuracy could be expected in reading the 6-in. length specimens than the shorter polystyrene specimen, the order of the accuracy being a function of the square of their lengths. By taking a measurement, moving to a new position, and returning to make a new adjustment and reading, the greatest discrepancy in readings was of the order of .002 in. For total plastic flow in material such as laminated phenolic, this represents about 1.5 precent reading error.

Specimens were cut accurately to size, and from measurements of physical dimensions, required loads were calculated and measured to the nearest .1 gm. for each specimen. Inaccuracies due to weights and specimen sizes were less than 1 percent. About the greatest source of inaccuracy occurred for specimens with greatest flow which deflected so much that the beam length was no longer 6 inches.

While it is not possible to make readings by the spark test as accurately as with the depth gage, deflections were recorded with greater ease and more rapidly. The diameter of pinhole in paper formed by the spar, was adjusted to about .005 in. diameter.

Effect of Time of Application of Load.—To determine the effect of time of application of load upon permanent set, laminated phenolics were tested at 2000 and 3000 lbs. per sq. in. maximum fiber stress. One set of weights was removed at the end of one hour, another set at the end of 24 hours, a third set at the end of 100 hours and the last set at 330 hours. Before permanent set was determined, specimens were allowed to remain unloaded for the same length of time for which they were loaded. The last reading is taken as permanent set from original dimensions. The data obtained are shown in Fig. 8.

The more rapid increase of permanent set under 3000 lb. per sq. in. is explained by the fact that the material was loaded beyond its *elastic limit*. Test data reveal that the plastics are capable of elastic deformation as well as plastic deformation under stress. Consequently, it must be assumed that the structure of plastics is such as to embody an elastic portion as well as a portion capable of exhibiting plastic flow. When the elastic portion of the structure is overstressed, as it is at 3000 lb. per sq. in., plastic flow will be greater.

Effect of Temperature.—All the test data indicating permanent set as a function of temperature are combined in one curve, Fig. 9. Two materials, polyvinyl chloride-acetate and cellulose acetate-butyrate, deflected so much during the 96-hour test under 1000 lbs. per sq. in. maximum fiber stress at a temperature of 125 deg. F., that the dead loads developing the stress rested on the bottom of the test box before the test was completed. The tendency to recover was observed only slightly in the case of the cellulose plastic. On the other hand, all other materials exhibited orderly deflection and recovery curves at this temperature.

Moduli of Elasticity.—Moduli of elasticity are readily calculated from instantaneous deformation or instantaneous recovery phenomena, where true elastic phenomena are observed. The moduli of elasticity for simple cantilever beams is calculated from the well known formula:

$$\text{Deflection} = WL^3/3\,EI$$

where E is the modulus of elasticity,
I is the moment of inertia,
L is the beam length,
W is the dead weight on end.

(Please turn to next page)

In making the above calculations, elastic deformation was observed with the aid of spark test apparatus within 5 seconds of applying load. In Table II are listed the moduli of elasticity of various plastics as calculated above. Some data are also given showing the change of modulus with temperature. Data are not given for cellulose plastics at 125 deg. F. because the 1000 lbs. per sq. in. test load exceeded the elastic limit, as evidenced by substantial differences between instantaneous deflection and recovery.

It is very significant that while the moduli of elasticity for many plastic materials decrease about 25 percent in going from 75 deg. F. to 125 deg. F., the rate of creep and magnitude of permanent set increase about 1000 percent, as shown in Figs. 9 and 10. Changes in physical properties have been noted in other tests[5] where tensile strength of polymethyl methacrylate decreased 50 percent in changing from 54 deg. F. to 122 deg. F. This change, however, is small as compared with changes in the rate of creep.

9—Permanent set of various plastics as a function of temperature. Specimens were subjected to a maximum fiber stress of 1000 lbs. per sq. in. for 4 days and allowed to recover for 4 days. 10—Creep of various plastics as a function of temperature when subjected to a maximum fiber stress of 1000 lbs. per sq. in.

Fig. 9

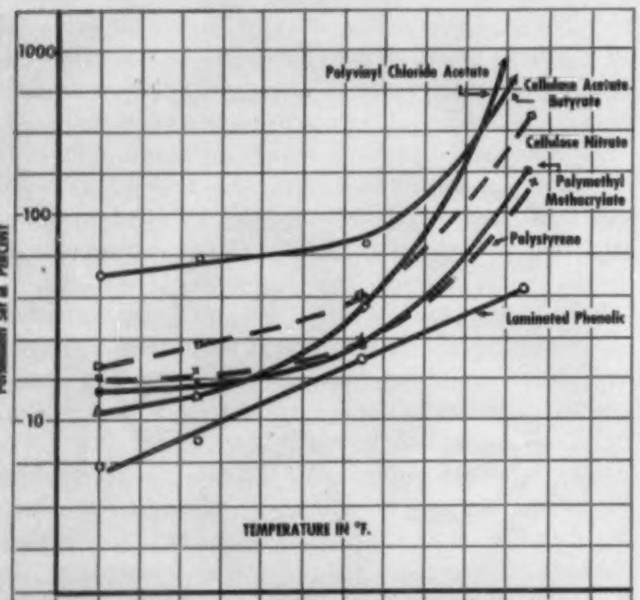


Fig. 10

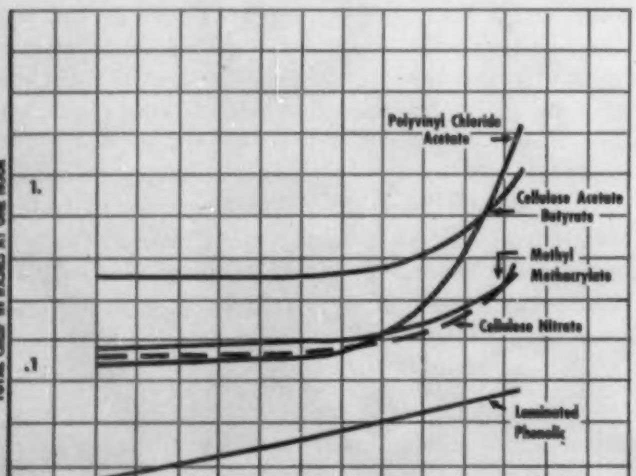


TABLE II.—MODULI OF ELASTICITY OF PLASTICS DETERMINED BY ELASTIC DEFORMATION MEASUREMENTS WITH SPARK RECORDING APPARATUS

Material[a]	Modulus of Elasticity—lbs. per Sq. In. At 75 deg. F.	At 125 deg. F.
Polyvinyl chloride-acetate	480,000	356,000
Polymethyl methacrylate	442,000	322,000
Laminated urea	1,580,000	1,500,000
Laminated phenolic, Grade XX	1,050,000	......
Cellulose nitrate	406,000	......
Cellulose acetate	318,000	......
Cellulose acetate butyrate	186,000	......

[a] All specimens were conditioned by heating at 50° C. for 24 hrs.

Typical results as recorded on a constant speed chart appear as in Fig. 11. Reading from the zero mark, the first point recorded is the deformation after 5 seconds, then 30 seconds and 60 seconds. Recovery upon removal of the load after 1 minute was observed for 1 hour. Observe how the specimens substantially recover from their deformation in 5 to 10 minutes, except for a certain amount of permanent set, and then begin to deflect again under their own weight (which creates a fiber stress of 50 to 100 lbs. per sq. in.). For analysis purposes the results may be transcribed to a semi-log paper, as was done for cellulose acetate in Fig. 12. Observe how, in this case, the instantaneous deformation under load (at 5 seconds) is substantially greater than the instantaneous recovery, in the ratio of 1.2 to 1. This indicates that 1000 lbs. per sq. in. at 125 deg. F. exceeds the elastic limit of cellulose acetate.

Creep observed between 5 seconds and 60 seconds of loading is quite substantial for a number of plastics, particularly at 125 deg. F.

Materials Arranged in Decreasing Order of Permanent Set Observed in 96-Hour Test at 125 Deg. F. (see Fig. 9)	Creep from 5 Sec. to 60 at 125 deg. F. as % of Deformation at 5 Seconds
Polyvinyl chloride-acetate	25.4
Cellulose acetate-butyrate	15.0
Cellulose nitrate	12.0
Polymethyl methacrylate	8.0
Polystyrene	..
Laminated phenolic	..

However, as will be recognized from Figs. 9 and 10, the order of the above materials with respect to creep

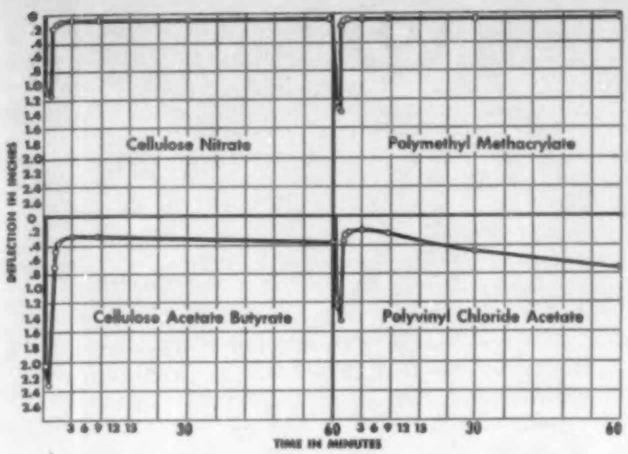


Fig. 11

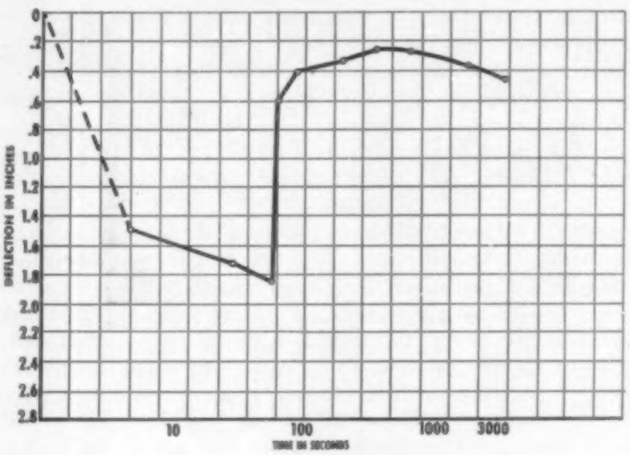


Fig. 12

11—Typical chart recordings by spark apparatus ofdeformation and recovery of plastics at 125 deg. F. 12—Deformation and recovery of cellulose acetate of 0.075 in. thickness subjected to a maximum fiber stress of 1000 lbs. per sq. in. at 125 deg. F.

phenomena change with temperature, and polyvinyl chloride-acetate which was the poorest at 125 deg. F. becomes one of the best at 20 deg. F.

A final set of tests is reported in Fig. 13 on resin-bonded veneers. For the same time of cure at 300 deg. F. and same bonding pressure, creep of a specimen bonded with a phenolic resin varnish was slightly higher than that of a specimen made with the phenolic resin film as bonding agent. The loads were applied for 15 minutes and recovery noted for 15 minutes. Permanent set was small in all cases, of the order of 1 to 2 percent of the elastic deformation. Measurements were made on apparatus using the spark recorder. The effect of bonding pressure upon creep was clearly noted for birch and poplar veneers.

Conclusions

It is quite apparent from these tests that the often neglected creep and cold flow phenomena become increasingly important for thermoplastic materials at temperatures above 80 deg. F. As pointed out, the increase may be as much as 1000 percent while changes in physical constants are very much smaller. These results may be readily recognizable from data appearing in Fig. 10. Until thermoplastics are developed which will creep much less at 120 deg. F., their applications to structures are unlikely unless they are reinforced with some supporting metal member.

Cold flow, which is defined in this paper as that stage of plastic flow in which the rate of flow becomes substantially constant, was observed for several of the materials at temperatures below 85 deg. F. However, a number of hours usually elapses before this state is reached. That creep will occur at even the lowest stresses is evidenced by plastic deformation of the beams under their own weight (stress 50–100 lbs. per sq. in.) at 125 deg. F. for thermoplastics.

Concerning the tests themselves, considerable time must be spent in making measurements in conducting the long time creep tests, and for this reason it was felt that a test method which would give the desired comparative data in a few minutes would be desirable. It was with this purpose that the spark recorder was developed and representative data presented. The big advantage lies in the fact that deformation can be observed in a few seconds, and hence true elastic phenomena recorded. Even a wait of 60 seconds to make measurements at this temperature involves considerable plastic flow.

This would likewise be true for pure compression and tension tests on universal testers, which in not being able to apply full load instantaneously incur a substantial amount of creep before measurements can be made. It is felt for this reason that there is considerable merit in a short time creep test by beam deformation methods, using a spark recorder for deflection measurements. A comparison of the plastics by this method was recorded in one of the tables. (*Please turn to page 110*)

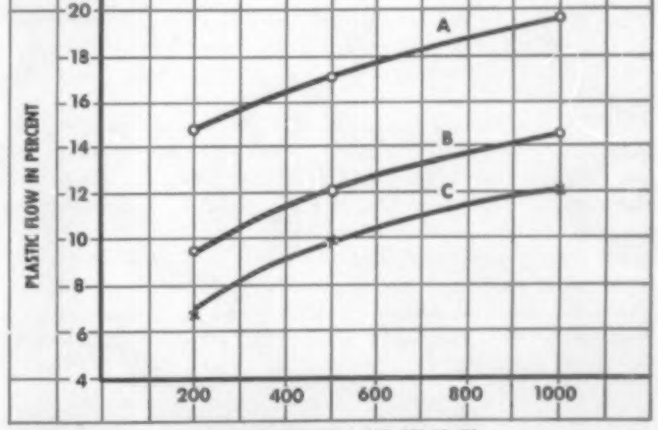


Fig. 13

13—Creep properties of resin-bonded plywoods subjected to a maximum fiber stress of 2000 lbs. per sq. in. for 15 min. at 122 deg. F.

Aver. Mod. Elas. Birch—1,100,000 p.s.i.
Aver. Mod. Elas. Poplar—1,000,000 p.s.i.
4 ply (2 cross-2 length) of 1/24 in. Birch
4 ply (2 cross-2 length) of 1/20 in. Poplar
A—Birch bonded with 3 "Tego" films between plies
B—Poplar bonded with 3 "Tego" films between plies
C—Poplar bonded with 1 "Tego" film between plies

A.C.S. symposium on high polymers

EMPHASIS on basic research concerning factors involved in the physical behavior of plastics marked the program of the plastics group of the American Chemical Society at its semi-annual convention held in Atlantic City during the week of September 8. The symposium on progress in high-polymer plastics was presented under the chairmanship of Dr. S. L. Bass before an audience of approximately 500 chemists.

The Division of Paint, Varnish and Plastics Chemistry elected the following officers for the year 1942: S. L. Bass, Dow Chemical Co., Chairman; Wm. W. Bauer, Pittsburgh Plate Glass Co., Chairman-Elect; A. C. Elm, New Jersey Zinc Co., Secretary-Treasurer; C. E. Fawker, Pyroxylin Products, Inc., and V. H. Turkington, Bakelite Corp., members of the Executive Committee. The outgoing chairman, Mr. G. G. Sward, National Paint, Varnish and Lacquer Association, received a unanimous vote of thanks for his unstinted service to the Division in various official capacities during the past few years. The customary dinner of the Division, held at the Hotel Dennis jointly with the local (Philadelphia) Production Club, proved to be as entertaining and as well attended as in the past. The next meeting of the Division will be at the convention in Memphis, Tenn., during the week of April 20, 1942.

Abstracts of the ten papers comprising the symposium on high polymers are presented herewith.

PHASE TRANSITION AND ELASTIC BEHAVIOR OF HIGH POLYMERS. H. Mark, Polytechnic Inst., B'klyn.

It is generally acknowledged that the elastic behavior of high polymers is of a rather composite nature. In order to understand it, it seems to be appropriate to attempt to resolve the total process into its different elementary steps. In the case of rubber, it is probable that at least four different elementary processes cooperate in order to produce the actual behavior of the material. At very low stresses, the Van der Waals cohesion of the different segments in the curled-up chains is overcome and the chains are brought into a more extended state. This type of elasticity has been first emphasized by E. Mack. The kinetic elasticity of long-chain molecules is due to the fact that the extended state is less probable than a state of intermediate curl-up. While the alignment of the chains takes place, molecular attraction between different chains causes crystallization. The crystallized phase has a certain amount of elasticity which is characterized by a high elastic modulus. An attempt is made to coordinate the above-mentioned elementary processes and to propose an explanation for the stress-strain curve of high polymers consisting of long-chain molecules.

THE ELECTRICAL PROPERTIES OF POLAR POLYMERS. Raymond M. Fuoss, Research Lab., General Electric Co.

The polar polymers so far investigated show two maxima in absorption as a function of temperature at fixed frequency. The mechanism underlying the low-temperature maximum is at present unknown, but the high-temperature maximum can be completely described in terms of dipole orientation. Several marked contrasts to polar liquids appear: the absorption, as a function of frequency, is much broader than that of the corresponding monomer, and appears at very much lower frequencies. Further, the static dielectric constant is always higher for the polymer. The width of the absorption maxima indicates that a distribution of relaxation times is involved; physically, the distribution corresponds to a time average over the many orientations produced by flexible chain structure of the polymer. For polyvinyl chloride and polyvinyl acetate, the most probable relaxation time, about which the distribution centers, is shown to be proportional to the degree of polymerization.

The time of relaxation is proportional to the internal viscosity of the plastic, as is shown by a comparison of d.c. and a.c. properties for polyvinyl chloride systems and for polyvinyl choroacetate. The high viscosity causes the peak absorption to appear at relatively low frequencies. Temperature and plasticizer content are the chief independent variables which control the internal viscosity, and hence the location of the maximum loss factor. The temperature coefficient of the internal viscosity of plastics leads to an associated energy of the order of 30 to 60 kg-cal, depending on the polymer and the nature and amount of plasticizer. The shape and size of the plasticizer molecule also influence the loss factor and dielectric constant.

The moments μ per monomer unit are independent of the degree of polymerization. For dilute polyvinyl chloride systems, $\mu = 1.7 \times 10^{-18}$; for unplasticized polyvinyl acetate, $\mu = 2.3 \times 10^{-18}$; and for the chloroacetate $\mu = 4.9 \times 10^{-18}$. These values agree with moments calculated from those of the corresponding monomers in the gas phase. The fact that the polymers have static dielectric constants much larger than those of the monomer in the liquid phase is explained on the basis of suppressed association in the polymer. In the monomer, the dipoles are on molecules which are mechanically independent, and hence free to rotate in each other's fields, but in the polymers, the dipoles are held to the chain by primary valence bonds, and free orientation, which causes mutual compensation of moments, is impossible.

EFFECT OF TEMPERATURE ON MECHANICAL PROPERTIES OF POLYSTYRENE. H. K. Nason and R. F. Hayes, Monsanto Chemical Co., Plastics Div.

The tensile, flexural and impact properties of several types of polystyrene, injection molded under carefully controlled conditions, were studied at temperatures from −75 deg. to +110 deg C. A critical "transformation" point was observed in all cases at about 80 deg. C. to 85 deg. C. At this point polystyrene passes from a hard, glasslike solid to a ductile plastic. This transformation point in mechanical properties coincides with the inflection point in the density-temperature curve reported by Patnode and Scheiber and by Ueberreiter and his co-workers. At 100 deg. C. to 110 deg. C., polystyrene changes gradually from the ductile to a rubbery state. This rubbery condition continues up to at least 175 deg. C. without conversion to a fluid state. As the temperature is reduced below the transformation point, both tensile strength and elongation of polystyrene increase, and this trend, which is indicative of increased toughness at lower temperatures, continues down to at least −75 deg. C. A similar relation holds for flexural strength and deflection. Impact strength data confirm that polystyrene is tougher at low temperatures than at room temperature or at temperatures just below the transformation point. Some commercial uses, notably refrigerator parts, take advantage of the low-temperature toughness of polystyrene.

INDUSTRIAL PROGRESS IN SYNTHETIC RUBBERLIKE POLYMERS. Howard I. Cramer, Sharples Chemicals, Inc.

The development of synthetic rubberlike polymers is being accelerated greatly by the national defense emergency. The annual production of these new materials so vital in defense has now increased to the point where it can be expressed in tens of thousands of tons. Formerly the application of the synthetic rubbers depended upon their superiority in some specific respects over

natural rubber. With the completion of the new plants now planned and under construction, sufficient of the synthetic product should become available, so that attention can be given to those tonnage applications involving simple replacement of the natural product.

VINYLIDENE CHLORIDE PLASTICS. W. C. Goggin and R. D. Lowry, Dow Chemical Company.

Vinylidene chloride plastic is discussed from the standpoint of history, chemical and physical structure, outstanding characteristics, methods of fabrication, and applications. These resins differ from familiar plastic materials in that they exhibit crystallinity. This crystallinity is demonstrated by x-ray diffraction patterns. While presenting some mechanical problems, the control of this crystallinity offers a wide range of properties and unique fabrication techniques. The extrusion and continuous orientation of vinylidene chloride plastic is now a commercial accomplishment. Injection molding of these resins, along with control of molding properties, is described. Applications are cited illustrating some fabrication methods as well as the unusual characteristics of chemical inertness, water resistance, high strength, toughness, and abrasion resistance.

EFFECTS OF HEAT, SOLVENTS, AND HYDROGEN-BONDING AGENTS ON THE CRYSTALLINITY OF CELLULOSE ESTERS. W. O. Baker, C. S. Fuller and N. R. Pape, Bell Telephone Laboratories.

Cellulose triacetate, cellulose tributyrate and a cellulose acetate-butyrate high in acetyl containing 0.2 mole of free hydroxyls per glucose anhydride are highly crystalline when allowed to solidify near their melting points. When the melts are quenched, for example at 200 deg. below the fusion temperatures, X-ray patterns indicate highly disordered configurations of the chains, showing especially disorganization in directions perpendicular to the long axes. Such heat treatment can thus produce all states of the cellulose chain from the highly crystalline to the highly amorphous, and the latter are stabilized in the solid by the high interchain forces, rigidity, and, for the partial ester, hydrogen bonding, expected from the cellulose structure.

Amorphous configurations are converted in the solid state to crystalline by temperatures sufficient to give chain segments the kinetic energy requisite for rotation into the lattice arrangement. This process resembles the behavior of the linear polyamides (Fuller, Baker and Pape, *J. Am. Chem. Soc.* *62*, 3275 (1940)). The crystallization of the quenched materials is a rate process with a considerable temperature coefficient. The latter was investigated by photometer intensity measurements of the Debye-Scherrer patterns produced by annealing for successively increasing times at each of several temperatures. The temperature coefficients reflect structural differences, e.g., the partially internally plasticized tributyrate is converted from amorphous to "completely" crystalline in 20 minutes at 150 deg. C, the triacetate requires three hours at 200 deg. C, while the hydrogen-bonded acetate-butyrate is not changed below its softening point by heat alone. Further information on the forces in the solid ester is gained by the comparison that while a strong hydrogen-bonding agent, water, converts the acetate-butyrate in three hours at 100 deg. C., five hours are required for the triacetate under the same conditions. Solvent vapors readily crystallize all of the quenched solids.

The results indicate a surprisingly large degree of rotatory motion of segments in cellulose ester chains at relatively low temperatures. Elastic properties of swollen cellulose and cellulose derivatives may thus be understood as the result of kinetic chain kinking. The critical importance of even small amounts of residual hydrogen bonding in cellulose derivatives in increasing chain cohesion is directly shown by the diffraction results. Likewise, the action of plasticizers in reducing interchain action probably depends specifically on the neutralization of two different types of forces. The first are hydrogen bonds which are relatively long range, probably falling off as $1/r^3$, and dispersion forces from the chain skeleton, falling off as $1/r^6$. Substitution of longer chain acyl groups reduces especially these latter forces.

THE PYROLYSIS OF LACTIC ACID DERIVATIVES. THE CONVERSION OF METHYL ALPHA-ACETOXYPROPIONATE INTO METHYL ACRYLATE. Lee T. Smith, C. H. Fisher, W. P. Ratchford and M. L. Fein, Eastern Regional Research Laboratory, Bureau of Agricultural Chemistry and Eng., U. S. Dept. of Agriculture.

The carbohydrates in several abundant, domestic and annually reproducible agricultural commodities can be converted into the commercially important acrylate resins through lactic acid as an intermediate. The conversion of lactic acid into acrylic acid and its derivatives is being studied extensively in the Eastern Regional Research Laboratory. This paper describes the results obtained in an investigation of the pyrolysis of methyl alpha-acetoxypropionate (in which both the functional groups of lactic acid are esterified) and the effect of temperature, contact time, contact materials and other variables on the yields of the desired product, methyl acrylate, and the by-product, acetic acid.

QUINONE FORMATION DURING THE HYDROQUINONE-INHIBITED POLYMERIZATION OF METHYL METHACRYLATE. Hubert N. Alyea, Princeton U.

The rate of quinone formation was followed for a mixture of methyl methacrylate, benzoyl peroxide and hydroquinone. At certain concentrations this rate is independent of the hydroquinone concentration, but dependent on the peroxide concentration. This indicates that the hydroquinone does not inhibit by removing peroxide, but, instead, by breaking reaction chains which the peroxide has initiated. The number of quinone molecules formed is thus limited by, and a measure of, the number of chains started. Similar results were obtained when the polymerization, in the presence of hydroquinone, was initiated by *p*-chlorobenzoyl peroxide, *p*-nitrobenzoyl peroxide and *p*-toluyl peroxide.

SOLUBILITY BEHAVIOR OF POLYBUTENE IN PURE SOLVENTS. H. C. Evans and D. W. Young, Standard Oil Company of New Jersey.

A limited study has been made of the solubility of polybutene in sixty pure solvents at room temperature. By the use of the specific viscosity constant, at a concentration of 10 grams of polymer per liter, the degree of polybutene solubility has been calculated for 34 solvents. The viscosity of a number of the polymer solutions over the approximate concentration range of 10 to 80 grams per liter has been measured. Log N has been found not to be a linear function in the higher concentration ranges of polybutene when determinations were made by the Ubbelohde viscometer method. A table is given showing that pure solvents having dielectric constants greater than about 8 at room temperature will not dissolve high molecular weight polybutene.

CRITICAL DATA ON SOLVENTS AND PLASTICIZERS FOR USE WITH CHLORINATED RUBBER. J. W. Raynolds, Mellon Institute, and M. R. Radcliffe and M. R. Vogel, Binney & Smith Company.

A brief historical introduction describes various types of halogenated rubber, including the Raolin chlorinated rubber developed at Mellon Institute. The early investigations disclosed a lack of sufficient comprehensive data on solvents and plasticizers for use with chlorinated rubber.

A series of tables is presented showing the dilution ratios of various solvents, tolerance ratios of non-solvents, compatibility of plasticizers, and film properties imparted by a representative group of plasticizers. There is included a discussion of the viscosity of solutions versus concentration in various solvents; also a discussion of blending different viscosity materials.

Color fastness of plastics to light*

Scope

1. (*a*) This method of test is intended to establish a laboratory procedure for evaluating the relative resistance of plastics to change in color when exposed to sunlight. Plastics may change in color because of the action of solar radiation on the dyes or pigments or on the plastic base. The 50-hr. test described in this method has been found to be roughly equivalent to 100 to 200 hr. of exposure to sunlight in Washington, D. C., during the months of August and September between 9:00 a.m. and 4:00 p.m., the equivalence varying for differently colored samples of plastics.

(*b*) This method is not intended to show the resistance of plastics to weathering, that is, continuous exposure of the materials out-of-doors.

Apparatus

2. The apparatus (Fig. 1) shall consist of the following:

(*a*) *Lamp.*—A General Electric sunlamp, model BM 12, or an equivalent lamp, equipped with a reflector approximately 15 in. in diameter at the lower rim, and an S-1 bulb which has been in use at least 50 hr. and less than 550 hr. The S-1 bulb consists of a combination tungsten filament-mercury arc enclosed in Corex D glass which absorbs most of the ultraviolet radiation below 2800 Å. The bulb is rated at 450 w.

(*b*) *Disks.*—A phonograph turntable, operating at 33 rpm., on which shall be mounted an aluminum disk approximately 17 in. in diameter and 0.1 in. in thickness. Two sets of 21 brass machine screws and nuts shall be attached to the disk at holes equally spaced on concentric circles of approximately $3^3/_4$ in. and 6-in. radius, respectively. The screws may be size No. 10, 32 threads to the inch, $^1/_2$ in. in length with fillister head. Brass washers about $^5/_8$ in. in diameter and 0.05 in. in thickness shall be placed over the nuts to support the specimens about $^3/_{16}$ in. above the surface of the disk. A brass plate about 1 in. square and 0.05 in. in thickness shall be fitted over the outer row of screws to cover approximately one third of the outer portion of the specimen.

Test specimen

3. The test specimen shall be approximately 2 in. in length and 1 in. in width. The material shall be tested in the thickness as received.

NOTE 1.—It is desirable to include a test specimen of known discoloration behavior in each test series in order to guard against the use of a defective bulb. A specimen of transparent cellulose nitrate plastic $^1/_8$ in. in thickness has been found to be satisfactory for the purpose of this test.

Procedure

4. The specimens shall be fastened to the disk by means of the cover plates and nuts. The disk shall be centered under the S-1 bulb so that the plane of the specimens is 7 in. from the bottom of the bulb. The test shall be conducted in a room maintained at 25 ± 1 deg. C. by means of circulating air. The apparatus shall be located in an open space in this room with unimpeded natural circulation on all sides; it shall not be confined in a cabinet. The specimens shall be rotated under the light for 50 hr., then removed and examined visually for color changes.

NOTE 2.—When the apparatus is not confined in a cabinet and the air temperature is 25 deg. C., the temperature of a colorless transparent plastic, $^1/_8$ in. in thickness, has been found to be about 50 to 60 deg. C. under the above conditions. The temperature of the specimen was measured, immediately after stopping the turntable, by means of a thermocouple inserted in a hole bored longitudinally in the plastic. It is undesirable to permit the temperature to go higher than 60 deg. C. as indicated by this test, because effects not typical of exposure to sunlight may be produced at higher temperatures. On the other hand, if the test conditions are such that the temperature of the specimens is considerably lower than the 50 deg. C. indicated by the above procedure, the rate of change in color may be considerably retarded. Such an undesirable effect is produced by circulating air directly over the specimens by means of an adjacent fan.

(*Please turn to page 112*)

Fig. 1—Apparatus for color fastness test of plastics

* The above proposed tentative method of test for color fastness of plastics to light (A.S.T.M. designation: D 620–411) is published here by permission of the American Society for Testing Materials.

BASE HIT

TENITE scores another hit as a replacement of zinc, by stepping up production and lowering the manufacturing costs of cup dispenser bases.

These new Tenite bases are injection molded complete in only a few seconds—eliminating the metal machining, polishing, and plating operations formerly required. The parts have a lustrous finish, and are made ready for assembly by removing the gate scrap.

Tenite weighs only one-fifth as much as zinc, yet it is exceptionally strong and resilient. Its smooth colorful surface will not tarnish or become dull with wear. The choice of Tenite in place of metal has simplified the construction and improved the appearance of many products, including sales registers, shower nozzles, vacuum sweepers, floor lamps, and building hardware.

A 28-page book on Tenite, describing and illustrating some of its many uses, will be sent on request.

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Paper cup dispenser bases molded by Chicago Molded Products Corp. for Paper Container Mfg. Co.

Plastics digest

This digest includes each month the more important articles of interest to those who make or use plastics. Mail request for periodicals mentioned directly to individual publishers

General

INDUSTRIAL UTILIZATION OF THE COFFEE PLANT. C. E. Nabuco de Araujo, Jr., and H. S. Polin. A. C. S. News Edition *19*, 877–81 (Aug. 25, 1941). The basic process for making Caffelite involves grinding the bean and putting the resulting meal through a solvent operation to remove the oil and caffeine. These are separated, and other materials carried over in the extraction are returned to the oil-free meal. The meal is mixed with water and usually an acid catalyst, and autoclaved at a temperature around 300 deg. F. It is then washed, neutralized and dried under vacuum. The powder is molded at about 350 deg. F. and the heat treatment produces further polymerization reactions. A 5-story semicommercial plant for producing Caffelite, caffeine and coffee oil has been completed in the city of São Paulo, Brazil. The plant will handle 1000 pounds of coffee beans per hour. A full-size factory to process 5,000,000 bags (132 pounds each) of coffee per year is to be erected during the current year

PLXWEVE CT-6A TRAINER. Curtiss L. Bates. Aero Digest *39*, 194, 197 (Sept. 1941). Newly developed and recently perfected wood-plastic alloys of spruce, bonded with phenolic and urea-formaldehyde resins, are destined to play a major role in future aircraft production. An example of this new type of airplane construction is the CT-6A, 2-place, primary trainer monoplane. Wings, fuselage and tail surfaces are of wood-plastic geodetic construction, formed by wrapping airplane spruce spirally around laminated bulkheads. All components including fuselage are covered with doped fabric.

PLASTICS IN THE PRESENT EMERGENCY. T. S. Carswell. Chemical Industries *49* 158–60 (Aug. 1941). Among the most important examples of replacement of metals by plastics are housings for business machines, household accessories, electrical equipment and other products formerly employing stamped or cast metals. Also noteworthy is the adoption of large injection molded parts for use on household refrigerators. Definite gains in automotive applications are reported, including the possibility of sheet plastic license plates for 1942 or 1943. Military applications of plastics include ordnance items and gas mask parts.

LUMINESCENT MATERIALS AND THEIR WARTIME USES. Chem. and Ind. *60*, 551–4 (July 26, 1941). The materials available for the manufacture of luminescent devices are surveyed. Applications are reviewed with recommendations for materials to use for specific purposes.

Materials and Manufacture

POLYSTYRENE PLASTIC. Product Eng. *12*, 419–22 (Aug. 1941). The physical properties and typical applications of polystyrene are summarized. Charts are included which show the variation of tensile strength, ultimate elongation, flexural strength and flexural deflection with temperature from −40 deg. to 100 deg. C. and the variation of tensile strength and flow characteristics with average molecular weight over the range from 66,000 to 93,000. An interesting revelation is the fact that the strength of polystyrene increases materially at low temperatures.

FURFURAL: ITS DEVELOPMENT AND POSSIBILITIES. S. N. Farmer. Chemical Age *45*, 23–5 (July 12, 1941). A review of the uses of furfural in oil refining, synthetic resins, plasticizers and wetting agents.

PLASTICS AND CHEMICALS FROM PETROLEUM BASES. R. L. Wakeman. Nat. Petroleum News *33*, R226-8, R230-2, R237 (July 23, 1941). Plastics derived directly or indirectly from ethylene, propylene and butylenes include practically all types of resins, cellulose derivatives and synthetic rubbers. A bibliography of 20 references is appended.

RELATION OF CHEMICAL COMPOSITION OF FILLER PULPS AND COLOR OF WHITE UREA-FORMALDEHYDE PLASTICS. G. W. Ingle and H. F. Lewis. Paper Trade J. *113*, 35–8 (Aug. 21, 1941). The yellowness of the white plastics was related inversely to the alpha-cellulose content of the pulp and directly with the content of hemicellulose and the degradation products of celluloses and hemicelluloses. The wood resins and the tannins of the pulp filler were significant only when the alpha-cellulose content was 90 percent or more. On the basis of this work the following analytical constants represent the qualifications for a suitable pulp: a minimum alpha-cellulose content of 87.5 percent, a maximum pentosan content of 4 percent, a maximum solubility in 1 percent sodium hydroxide solution of 4 percent and a maximum wood resin content of 0.2 percent.

Molding and Fabricating

HOW TO PLATE METALS ON NONMETALS. A. Bregman. Iron Age *147*, 47–9 (June 19, 1941). The preparation of surfaces of plastics for receiving a conducting film and the processes for metallizing are described. Reference is made to three recent patents on this subject: namely, U. S. Patents 2,010,805; 2,063,034; and 2,214,646.

SCREW THREADS IN PLASTICS. Plastics 5, 76–8, 126-7, 144-6, 163-4 (Apr., June, July, Aug., 1941). A general comparison is made of different methods of thread production in plastics. Curves are shown for tensile strengths of cut and molded threads of various engaged lengths and for bolts of different metals. Practices and advantages in employing threaded metallic inserts to replace threads directly in the plastic are discussed. Consideration is also given to thread production by chasing and to the use of self-tapping screws.

Applications

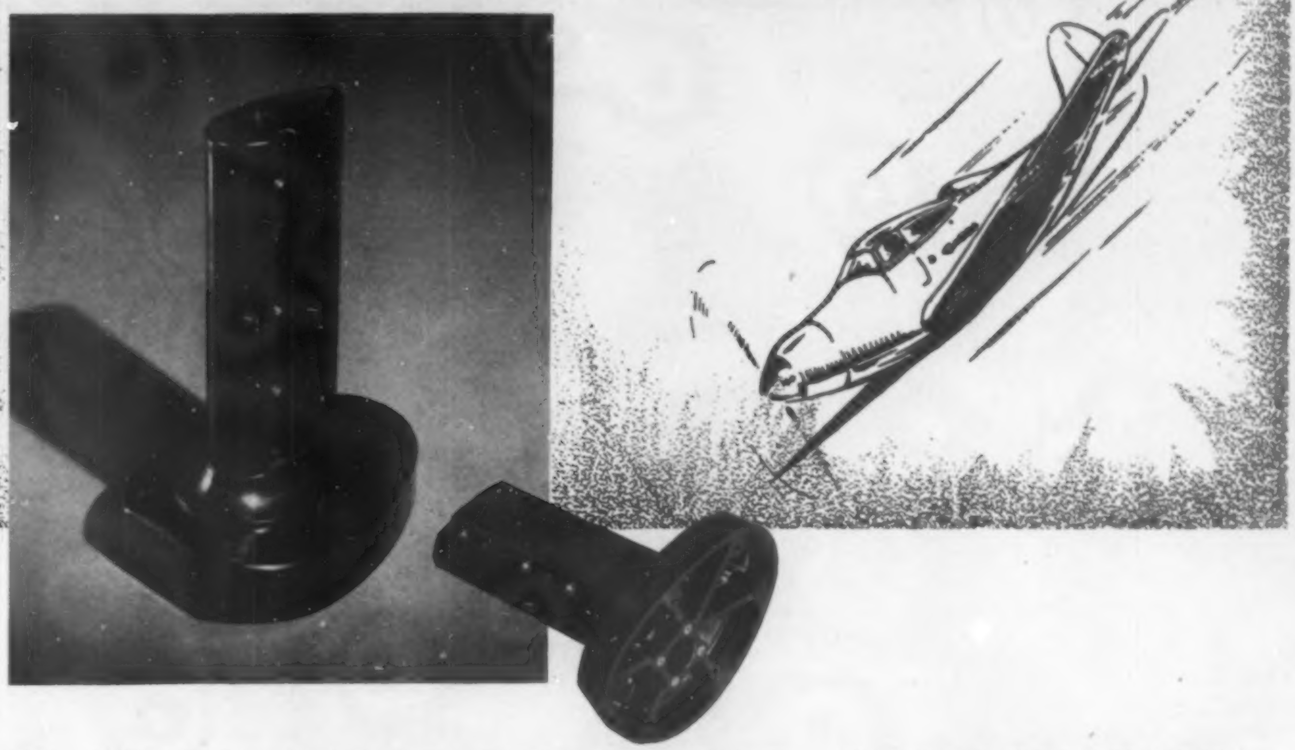
PROTECTIVE COATINGS. R. Gordon. Modern Packaging *14*, 35–40 (Aug. 1941). Various factors in the choice and application of lacquer coatings for wrapping materials are discussed. Chemical and physical properties of the new coatings, which include rubber and cellulose derivatives, vinyl and acrylic resins, are tabulated.

ADHESIVES AND CEMENTS. E. E. Halls. Plastics *4*, 264–8 (Dec. 1940); *5*, 5–8, 31–3, 48–50, 73–5, 102–4, 123-4 (Jan. to June 1941). A comprehensive discussion of modern "glues" based on synthetic plastics. Criteria for the ideal stickant are cited. A wide range of practical formulas are given for phenolic, urea, cellulose nitrate, cellulose acetate, polyvinyl, polyacrylic, polystyrene, alkyd, rubber, and casein adhesives. The chemistry of the compounds has been adequately explored, but the physics of their adhesion has been but little investigated. Certain generalizations based upon work already done on polar and non-polar relationships cannot escape criticism and certainly appear to present many anomalies.

PLASTICS FOR OPTICAL LENSES. British Plastics *13*, 76 (Aug. 1941). A patent review. Use of synthetic resins in place of Canada Balsam as cementing agents for a system of glass lenses and prisms is discussed. Various methods of forming lenses from acrylic resins are described. Acrylic and vinyl resins having refractive indexes from 1.49 to 1.62 are listed in this review.

Bucking 400 Mile Gales

AT SUB-ZERO TEMPERATURES



PLASTIC AIRCRAFT RADIO STANCHIONS

Engineered and Injection Molded

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FROM the standpoint of the terrific stresses and the rapid temperature changes it must withstand, this aircraft plastic radio stanchion is an interesting achievement in high speed injection molding.

In order to hold the weight to a minimum and reduce the amount of material, Erie Molding engineers cored large sections without weakening the structure. Particular care was required in designing the dies so that the plastic would flow properly and set without inducing internal stresses. The stanchion shown above, which is being molded for the fast, cannon-carrying Bell Airacobras, is approximately 7¾" high and requires 15 ounces of Monsanto Polystyrene. This material was selected because of its electrical insulating properties and good molding characteristics. A stanchion of similar design is molded for the Curtiss "Tomahawks".

It is quite unlikely that your plastic pieces call for such severe usage. Yet Erie's ability and facilities to produce such difficult injection moldings as these stanchions is a guarantee of the satisfactory handling of your requirements.

Above: Assembling mast and Erie plastic stanchion at the Bell Aircraft Corporation.

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U. S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 10 cents each

COLORING POLYMERS. C. T. Kautter and K. Feuerstein (to Röhm & Haas Co.). U. S. 2,250,958, July 29. Embedding a layer of color material in a plastic by covering the mold surface with a dry pigment in an organic binder which is insoluble in the resin to be molded, and forming the resin by polymerization in the mold.

PLASTIC TUBES. H. S. Riddle (to Monsanto Chemical Co.). U. S. 2,250,967, July 29. Winding one or more plastic 'rods around a mandrel, cementing the adjoining edges together, slitting the resulting tube lengthwise to form a sheet and shaping the sheet into a tube so that the ribs run lengthwise.

HOLLOW ARTICLES. K. Bratring (to Neocell Products Corp.). U. S. 2,251,109, July 29. Making high gloss hollow shapes from cellulose esters or ethers by dipping a rigid polished mold in a solution of the ester or ether, exposing the dipped article to moist heat and stripping it from the mold.

SLIPPER BEARING. Thos. L. Gatke. U. S. 2,251,126, July 29. A molded composition slipper bearing having a laminated core and envelope molded together as a unit.

ANION EXCHANGE. R. C. Swain (to American Cyanamid Co.). U. S. 2,251,234, July 29. Freeing water from undesirable anions by treatment with a nearly insoluble anion-active biguaindealdehyde condensation product.

WATERPROOF FOILS. E. Czapek (to Guaranty Trust Co.). U. S. 2,251,270, Aug. 5. Coating regenerated cellulose foils with a water-repellent coating of emulsified urea and alkyd resins, finally set by heat.

ADHESIVE TAPE. R. G. Drew (to Minnesota Mining & Mfg. Co.). U. S. 2,251,273, Aug. 5. Coating tape first with a rosin-rubber composition and then with nitrocellulose.

ACIDPROOF COATING. R. W. Moncrieff and A. Richmond (to Celanese Corp. of America). U. S. 2,251, 288, Aug. 5. Wood containers for acetic acid are coated on the inside with cellulose acetate (acetyl value about 58 percent).

GREASEPROOF PAPER. J. H. Shipp (to E. I. du Pont de Nemours and Co.). U. S. 2,251,296, Aug. 5. Greaseproofing paper by coating it with polyvinyl alcohol.

DIOLEFIN RESINS. F. J. Soday (to United Gas Improvement Co.). U. S. 2,251,297–8, Aug. 5. Condensing a polyhydric alcohol with maleic anhydride and isoprene or piperylene.

ABRASIVES. F. Brown (to Carborundum Co.). U. S. 2,251,437, Aug. 5. Use of a plasticized phenolic resin as binder for abrasive grains on a backing sheet.

COLORING POLYMERS. A. W. Hanson (to Dow Chemical Co.). U. S. 2,251,486, Aug. 5. Coloring a supercooled melt of vinylidene chloride resin by contact with a pigment dispersed in an organic liquid.

LINEAR POLYAMIDES. F. K. Watson (to E. I. du Pont de Nemours and Co.). U. S. 2,251,508, Aug. 5. Increasing the coefficient of friction of filaments or foils by treatment with an acid or acid halide.

POLYMERS. R. M. Joyce and D. M. Ritter (to E. I. du Pont de Nemours and Co.). U. S. 2,251,519, Aug. 5. Polymerizing cyclic amides by heating with an initial product formed from the amide and an alkali or alkaline earth metal.

TERPENE RESIN. J. B. Rust and I. Pöckel (to Ellis-Foster Co.). U. S. 2,251,806, Aug. 5. A resin which forms water-soluble alkali metal salts is formed from rosin and a terpene in presence of boron trifluoride.

MOLD. A. G. Snell (to Ashdowns Ltd.). U. S. 2,251,858, Aug. 5. A mold for shaping frames from a plastic composition has one section with a channel in which the plastic is molded, and another section which fills part of the channel when in place but which is removable.

PURIFYING UNSATURATES. C. W. Jordan (to United Gas Improvement Co.). U. S. 2,251,938, Aug. 12. Purifying resinifiable unsaturates from light oil by treatment with a reagent which removes color-forming impurities.

MOISTUREPROOF FOIL. P. Müller and O. Herrmann (to E. I. du Pont de Nemours and Co.). U. S. 2,252,091, Aug. 12. Coating transparent wrapping foils first with an interpolymerized maleic (or like acid): vinyl compound resin, then with a moistureproofing film of wax and a cellulose derivative.

EXTRUSION MOLDING. Millard F. Weida. U. S. 2,252,-107, Aug. 12. An extrusion molding machine with complementary mold blocks carried by a movable head and a support for the head.

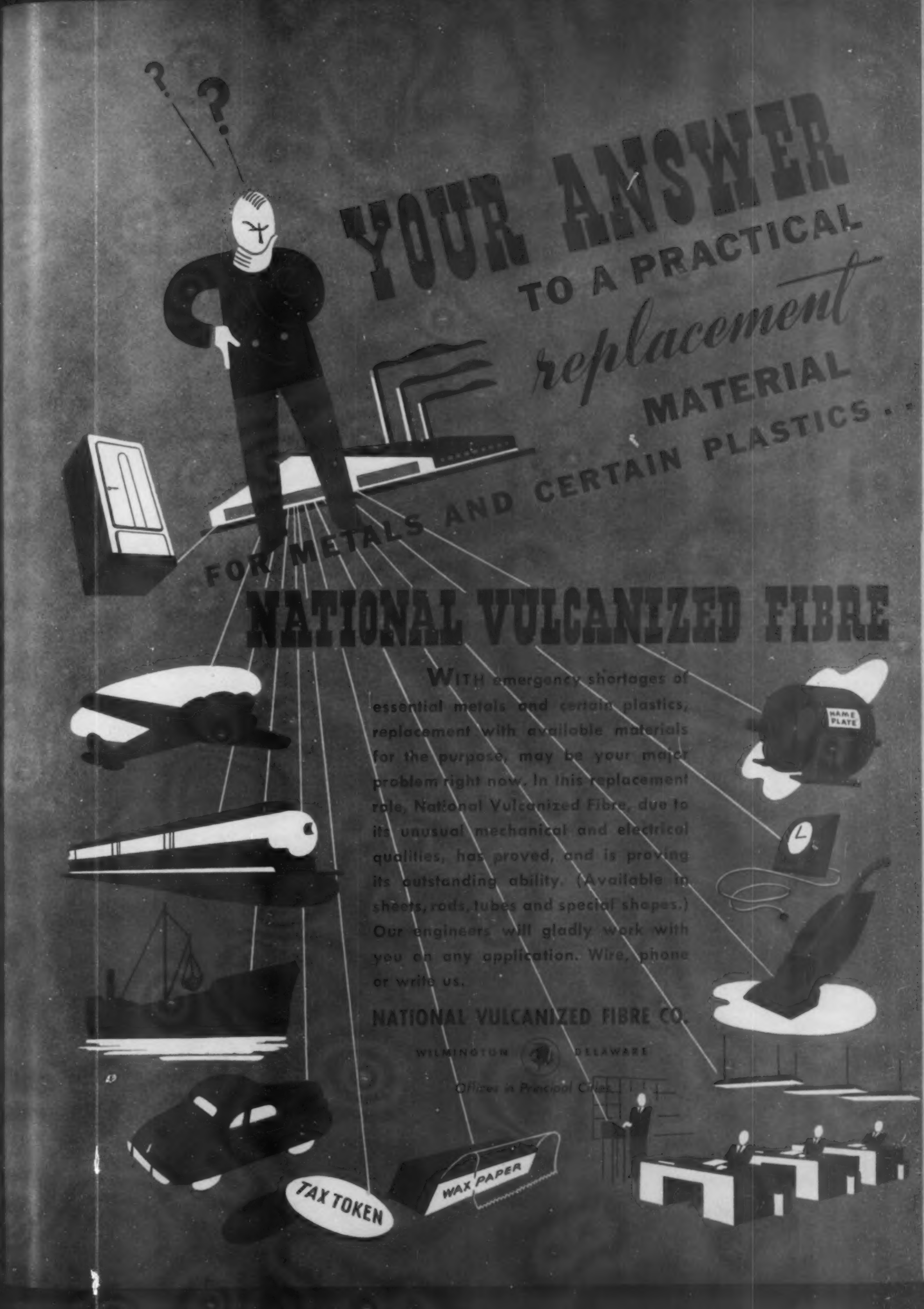
INSULATING BAT. Wm. M. Bergin and A. L. Simison (to Owens-Corning Fiberglas Corp.). U. S. 2,252,157, Aug. 12. Making insulation from loose unfelted glass wool fibers, a hydrocarbon oil lubricant and a urea-formaldehyde resin binder.

PLUGGING WELL FORMATIONS. Clyde H. Mathis (to Phillips Petroleum Co.). U. S. 2,252,271, Aug. 12. Plugging formations in wells by introducing the ingredients of an alkyd resin and controlling the time of set by means of benzoyl peroxide.

CEMENT BINDER. C. R. Payne and E. T. Severs (to Atlas Mineral Products Co.). U. S. 2,252,331, Aug. 12. Use of a water-insoluble phenolic resin, in an arrested stage of resinification, as binder in cement mortar.

SURFACE COATINGS. R. O. Roblin, Jr.; C. R. Caryl; W. W. Durant (to American Cyanamid Co.). U. S. 2,252,386; 2,252,394; 2,252,396–7–8–9, Aug. 12. Curing drying oil modified alkyd resin finishes by adding a dihydrocarbon substituted cyanamide, a metal cyanamid, a guanide, a guanidine salt, a guanylurea salt or an unsaturated nitrile.

CORE WINDINGS. M. M. Safford (to General Electric Co.). U. S. 2,252,440, Aug. 12. Windings for the core of a dynamoelectric machine are coated first with a thermosetting organic enamel and then with plasticized polyvinyl chloride to form an integral moistureproof oilproof mass. (*Please turn to next page*)



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COATING. C. M. Hull; M. H. Arveson (to Standard Oil Co. of Indiana). U. S. 2,252,485; 2,252,486, Aug. 12. Making a coating composition from highly chlorinated polyisobutylene and chlorinated paraffin wax in the ratio 90*10; and making a flexible, glossy, flameproof and waterproof coating of highly chlorinated polyisobutylene and chlorinated diphenyl.

CELLULOSE ETHER VARNISH. N. R. Peterson and J. L. Sherk (to Dow Chemical Co.). U. S. 2,252,521, Aug. 12. Incorporating an organo-soluble cellulose ether in oleoresin varnishes to form a clear, stable varnish.

POLYMERS. W. H. Carothers (to E. I. du Pont de Nemours and Co.). U. S. 2,252,554-5, Aug. 12. Forming interpolymers by heating together four or more polyamide-forming reactants including one or two diamines and one or two dicarboxylic acids, or a diamine, a dicarboxylic acid and a monoaminomonocarboxylic acid.

POLYMERS. E. P. Czerwin (to E. I. du Pont de Nemours and Co.). U. S. 2,252,557, Aug. 12. Making interpolymers from a mixture such as hexamethylenediamine, adipic acid and 6-aminocaproic acid.

SANDPAPER. F. J. Tone and H. C. Martin (to Carborundum Co.). U. S. 2,252,587, Aug. 12. Coating abrasive grains with a solid fusible resin, coating a backing with a liquid resin and joining the coated grains to the resin layer.

ABRASIVE DISKS. F. O. Albertson (to Albertson and Co., Inc.). U. S. 2,252,683, Aug. 19. Impregnating and coating fiber board disks with a phenolic resin, covering the tacky coating with abrasive grains and heating the disk, first mildly to expel the solvent and then more strongly to set the resin.

CHLORINATED RUBBER FILMS. J. M. Peterson (to Hercules Powder Co.). U. S. 2,252,728, Aug. 19. Unplasticized films with high permanent flexibility are prepared from alkali-digested rubber, chlorinated to 62-70% chlorine content.

DECORATIVE RESIN PRODUCT. W. R. Thompson (to Catalin Corp. of America). U. S. 2,252,821, Aug. 19. Making multicolored laminated resin products by joining hardened transparent surface-dyed sheets so that light transmitted and reflected by the successive color bands at various angles gives a multicolor effect.

LAMINATED POLARIZERS. Leon Pollack. U. S. 2,252,-898, Aug. 19. A shaped article which completely polarizes light transmitted at the polarizing angle is built up of transparent resin layers, each differing from the next in refractive index while alternate layers have the same refractive index.

FAST DRYING INK. J. G. Curado (to General Printing Ink Corp.). U. S. 2,252,917, Aug. 19. Making printing ink by cooking a drying oil with a drying oil modified phenylphenol or alkylphenol resin and grinding the product with a pigment.

PLASTICIZERS. J. B. Dickey and J. G. McNally. U. S. 2,253,064, Aug. 19. Ester amides of primary and secondary alkanolamines as plasticizers for cellulose esters or ethers.

PLASTICIZERS. J. B. Dickey and J. B. Normington (to Eastman Kodak Co.). U. S. 2,253,065, Aug. 19. Plasticizing cellulose derivatives with monocarboxylate esters of tertiary amine alcohols.

RUBBERLIKE RESIN. J. J. Russell (to General Electric Co.). U. S. 2,253,137, Aug. 19. Plasticizing polyvinyl chloride with a benzyl or like ester of a long chain dicarboxylic acid.

SIZING NYLON. E. W. Spanagel (to E. I. du Pont de Nemours and Co.). U. S. 2,253,146, Aug. 19. Sizing polyamide, polyester or polyether textile yarns with an interpolymer of methacrylic acid and such a compound as acrylic acid, styrene, vinyl acetate or methyl methacrylate.

CELLULOSE FORMATE FOILS. R. Weingand and Irene Koberne (to Sylvania Industrial Corp.). U. S. 2,253,157, Aug. 19. Dissolving cellulose formate in formic acid and evaporating a layer of the solution while depositing a film of condensed moisture on its surface, then precipitating the cellulose formate.

INJECTION MOLDING. Emil Hempel (to Franz Braun Akt.). U. S. 2,253,460, Aug. 19. In an injection molding machine the mold cylinder is supplied though a cylindrical conduit terminating in a number of tapered mixing chambers and surrounded by a hollow heating cylinder.

MOLD. W. T. Davis (to Wheeling Stamping Co.). U. S. 2,253,611, Aug. 26. A mold plate with openings having a shouldered offset so that the opening is wider at one face of the plate than at the other.

INJECTION MOLDING. E. R. Knowles (to Watson-Stillman Co.). U. S. 2,253,627, Aug. 26. A charging device for injection molding has an injection bore and internally threaded counterbore at the forward end, while the injection nozzle has an externally threaded shank engaging with the counterbore.

CELLULOSE ACETATE. A. A. New, D. R. Beckwith and W. A. Wiltshire (to International Standard Electric Corp.). U. S. 2,253,724, Aug. 26. Rapid continuous acetylation of cellulose by passage through glacial acetic acid containing 2-7% perchloric acid, then through a bath of acetic anhydride.

HETEROPOLYMERS. F. E. Frey, R. D. Snow and L. H. Fitch, Jr. (to Phillips Petroleum Co.). U. S. 2,253,775, Aug. 26. Polymerizing acrylic acid or its esters, or allylacetic or undecylenic acid, in presence of sulphur dioxide to form polymers containing sulphur dioxide.

TRANSPARENT FOIL. Wm. D. R. Straughn (to E. I. du Pont de Nemours and Co.). U. S. 2,253,821, Aug. 26. A flexible cellulose acetate foil, plasticized with isobutylene glycol.

MOLDING MACHINE. Gideon Sundback (to Talon, Inc.). U. S. 2,253,822, Aug. 26. A machine having a series of mold cavities which are filled successively by injection.

PLASTIC. E. C. Britton, G. H. Coleman and J. W. Zemba (to Dow Chemical Co.). U. S. 2,253,886, Aug. 26. Compounding polystyrene with an aryloxyalkyl ester of an unsaturated acid.

INSULATED WIRE. L. Carl and P. Nowak (to General Electric Co.). U. S. 2,253,967, Aug. 26. Coating wire with unplasticized cellulose triacetate and synthetic rubber.

CREASEPROOFING FABRICS. R. F. Conaway (to E. I. du Pont de Nemours and Co.). U. S. 2,254,001, Aug. 26. Impregnating cellulosic textiles with a lower alkyl ether of a methylolurea and baking to resinify the urea derivative.

Printing. J. D. Jenkins (to Pittsburgh Plate Glass Co.). U. S. 2,254,072, Aug. 26. Adding a plastic powder to printing ink, printing therewith, and heating the printed surface so that a non-smudging imprint is formed.

WASHING PLASTIC SHEETS. P. C. Lawson (to Pittsburgh Plate Glass Co.). U. S. 2,254,075, Aug. 26. Washing plastic sheet material by floating sheets thereof across a bar on jets of water and passing the wet sheets between squeegee rollers.

CASTING MACHINE. Nathan Lester (to Lester Engineering Co.). U. S. 2,254,119, Aug. 26. A plastic casting machine having separable die blocks forming a cavity, and a pressure cylinder communicating with the die cavity.

GLOSSY FOILS. F. P. Alles (to E. I. du Pont de Nemours and Co.). U. S. 2,254,200, Sept. 2. Humidifying a regenerated cellulose foil with an aqueous solution of an organic liquid and drying under tension to prevent wrinkling while permitting shrinkage.

(Please turn to next page)

WALKER-TURNER BAND SAWS

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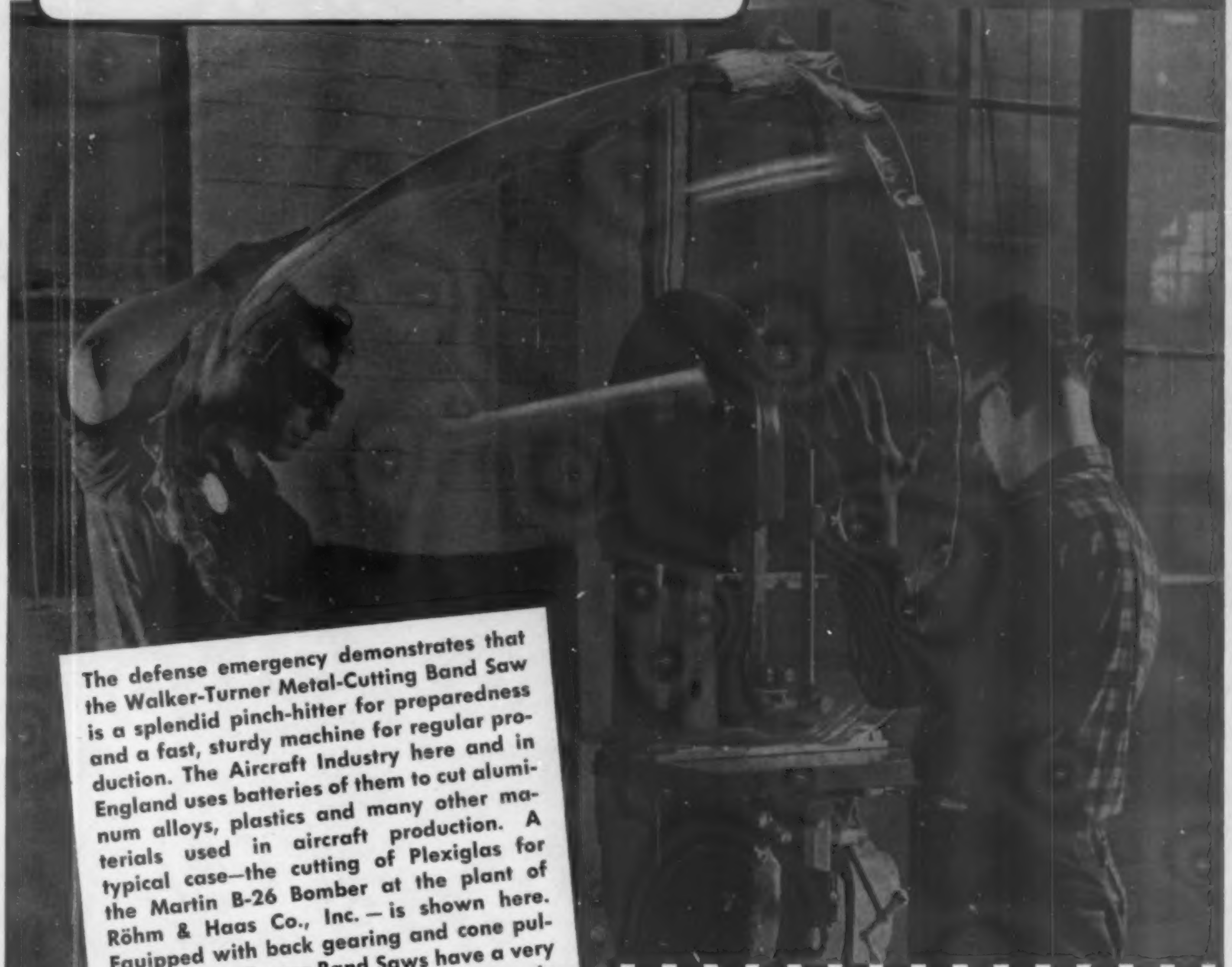

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DOLL EYES. Samuel Marcus (to Margon Corp.). U. S. 2,254,231-2, Sept. 2. Forming doll eyes from a single piece of solid transparent plastic shaped to form an iris portion.

ETHYLCELLULOSE. R. W. Swinehart and A. T. Maasberg (to Dow Chemical Co.). U. S. 2,254,249, Sept. 2. Ethylating cellulose to make a product which is soluble in organic solvents.

ABRASIVES. C. E. Wooddell (to Carborundum Co.). U. S. 2,254,254, Sept. 2. Mixing abrasive grains with a resin binder, pressing in a cold mold, and then heating the mold under a lower pressure.

HOLLOW ARTICLES. K. Bratring (to Neocell Products Corp.). U. S. 2,254,263, Sept. 2. Forming hollow articles by the dipping method, using a mold coated with a hardthermoplastic film to impart high gloss to the surface of the hollow article.

TAMPON. J. R. Crockford. U. S. 2,254,272, Sept. 2. A tampon the body of which is formed from viscose sponge.

MALEATE ESTER POLYMERS. H. T. Neher (to Röhm and Haas Co.). U. S. 2,254,382, Sept. 2. Polymers of 2-alkylallyl maleates, or their interpolymers with vinyl esters or ethers, styrene, acrylic and methacrylic acids or esters or derivatives thereof.

BUTTONS. L. R. Carley; F. G. Purinton (to Waterbury Button Co.). U. S. 2,254,418; 2,254,445-6-7, Sept. 2. Reinforced plastic buttons having a metal shell filled with plastic which is tightly rimmed by a peripheral flange; and similar shells with premolded plastic inserts which may or may not have insignia embedded in the plastic.

PLASTICS. Wm. H. Moss (to Celanese Corp. of America). U. S. 2,254,904, Sept. 2. Compounding cellulose esters or ethers, vinyl ester or ether resins or methacrylate resins with nucleus-halogenated di-p-phenylolmethane, di-p-phenylolpropane or the like.

MAKING BOXES. W. E. Helmstaedter (to Celluloid Corp.). U. S. 2,255,116-7, Sept. 9. Apparatus for stamp-molding boxes from thermoplastic films, foils or sheets, and a process for stamp-molding boxes and then cutting the molded box from the rest of the stock.

SULPHIDE POLYMER. Jos. C. Patrick. U. S. 2,255,228, Sept. 9. Forming a methylene disulphide polymer by reacting an alkali metal disulphide with a reactive methylene compound.

SOLVENT FOR RESINS. W. Reppe, O. Hecht and F. Oschatz (to General Aniline and Film Corp.). U. S. 2,255,229, Sept. 9. Dissolving a polymerized monovinyl compound in tetrahydrofuran.

WAX SUBSTITUTE. F. W. Corkery (to Pennsylvania Industrial Chemical Corp.). U. S. 2,255,242, Sept. 9. Compounding a fat with a coumarone-indene resin to form an artificial wax.

MALEIC ACID RESIN. C. Ellis (to Ellis-Foster Co.). U. S. 2,255,313, Sept. 9. Condensing a glycol with maleic acid or a derivative thereof, adding a compound with an olefin double bond and interpolymerizing the mixture.

WOOD GRAIN EFFECTS. P. C. Schroeder (to N. W. Fisher, 51 percent). U. S. 2,255,335, Sept. 9. Decorating plastics with wood grain effects in intaglio by etching wood to remove soft portions and forming an impression in the plastic.

POLYISOBUTYLENE. J. Kunc and F. L. Miller (to Standard Oil Development Co.). U. S. 2,255,388, Sept. 9. Separating linear iso-olefin polymers into high, medium and low polymers by dissolving the polymer in a hydrocarbon and adding a precipitant in successive portions.

ISOBUTYLENE INTERPOLYMERS. W. J. Sparks and C. W. Muessig (to Standard Oil Development Co.). U. S. 2,255,396, Sept. 9. Interpolymerizing isobutylene with phenylacetylene in presence of a Friedel-Crafts catalyst at −50 deg. C.

CYCLOPENTADIENE POLYMER. W. H. Carmody (to Neville Co.). U. S. 2,255,409, Sept. 9. Making a resin from cyclopentadiene by adding unsaturates from solvent naphtha and polymerizing the mixture in presence of aluminum chloride.

POLYMERIZATION INHIBITOR. G. F. D'Alelio (to General Electric Co.). U. S. 2,255,483, Sept. 9. Use of isoascorbic acid to inhibit polymerization of methy methacrylate.

VINYL RESIN. R. C. Feagin and J. G. E. Wright (to General Electric Co.). U. S. 2,255,487, Sept. 9. Use of phenoxypropene oxide or amylphenoxypropene oxide as a plasticizer to impart elasticity and thermal stability to vinyl chloride resins.

PACKING. W. G. Current (to Garlock Packing Co.). U. S. 2,255,504, Sept. 9. Making laminated packing rings by impregnating fabric with a curable binder, rolling the fabric into a blank, molding and curing.

POLYSTYRENE. E. C. Britton and W. J. Le Fevre (to Dow Chemical Co.). U. S. 2,255,729, Sept. 9. Purifying polystyrene type resins by swelling in butanol or a higher alcohol and removing the alcohol.

CELLULOSE ACETATE. A. Sonneveld (to Transtone Corp.). U. S. 2,255,828, Sept. 16. Compounding cellulose acetate with 30-40 percent triacetin and 30-40 percent tributyl phosphate.

CHLOROPRENE PLASTIC. J. N. Kuzmick and L. S. Hilton (to Raybestos-Manhattan, Inc.). U. S. 2,255,891, Sept. 16. Compounding chloroprene polymers with a synthetic resin which controllably decreases stretch.

HECTOGRAPH BLANKET. W. J. Champion (to Ditto, Inc.). U. S. 2,255,912, Sept. 16. Coating paper sheets with a gelatin composition and then with a cellulose ester lacquer.

LIGHT POLARIZER. H. G. Rogers (to Polaroid Corp.). U. S. 2,255,940, Sept. 16. Shrinking and then stretching transparent sheets of polyvinyl alcohol or polyvinylacetal resin to form polarizer sheets for optical uses.

PLASTICIZER. R. P. Cosgrove (to Plaskon Co., Inc.) U. S. 2,255,995, Sept. 16. A crystalline plasticizer for thermosetting urea-formaldehyde resins is made by reacting triethanolamine with *p*-toluenesulphonyl chloride in presence of pyridine.

HARDENED ARTICLES. A. M. Howald and L. S. Meyer (to Plaskon Co., Inc.). U. S. 2,255,998, Sept. 16. A self-hardening molding composition of plaster of Paris and an aqueous solution of a urea-formaldehyde resin and a hardening agent for the resin.

FOOT LAST MOLD. Rufus P. Redmond. U. S. 2,256,036, Sept. 16. Placing a parting strip in a plastic material and pressing the subject's foot into the plastic to conform the parting strip to the foot contour.

TAYLOR LAMINATED PLASTICS
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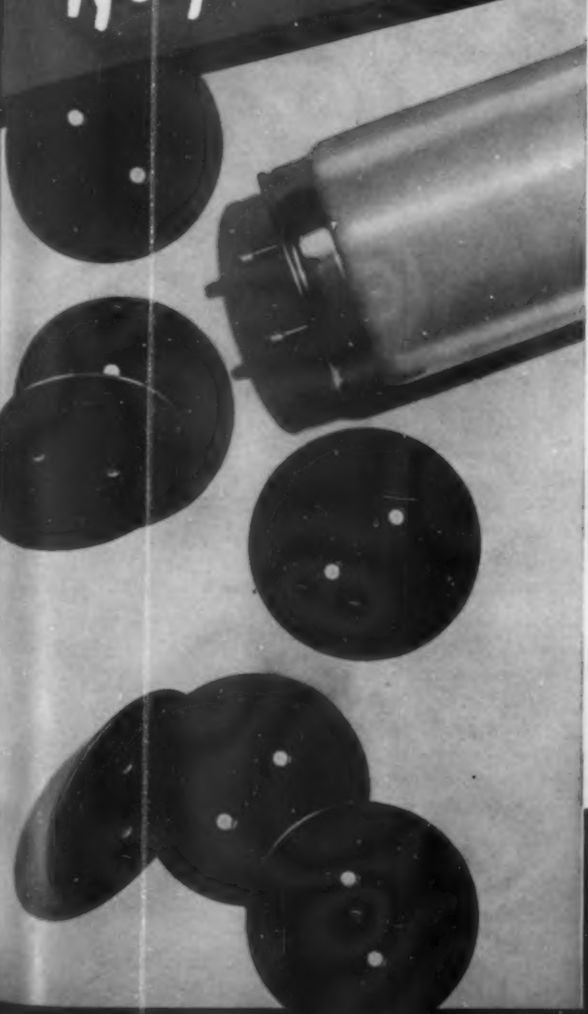

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Laboratory control of product quality and uniformity at the Taylor Mill and the most modern facilities for fabrication to the exact specifications of the manufacturer, have led many vulcanized and phenol fibre users to place the whole responsibility for their insulating parts with Taylor.

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Publications

Write direct to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices

The Chemical Formulary—Volume 5

Editor-in-Chief, H. Bennett, F.A.I.C.
Chemical Publishing Co., Inc., Brooklyn, N. Y.
Price $6.00 **676 pages**

Latest volume of The Chemical Formulary has appeared, carefully compiled for quick reference of commercial formulas and recipes for making thousands of products in a wide range of industries. A partial list of subjects covered includes adhesives, synthetic resins, welding, ceramics, cosmetics, lacquers, inks, soaps and glues. Sufficient new formulas have been added to this volume by the editors to broaden and bring up to date volumes 1 to 4. Although the chemist, purchasing agent, engineer and those in the plastics industry will find the book a handy reference, schools and colleges may also profit by the practical information between its covers. H. S.

Industrial Plastics, 2nd Edition

by Herbert R. Simonds

Pitman Publishing Corp., 2 West 45th St., New York, 1941

Price $4.50 **385 pages**

The printing of a new edition of this book has enabled the author to add new material relating to recent developments and to bring the statistical and tabular information up to date, with an increase of about 15 pages over the total of the previous book. Many of the typographical and factual errors in the first edition have been corrected. However, the author still credits cellulose acetate with being predominant over vinyl plastics in the safety glass field (pages 45 and 63), which situation had already been reversed when the earlier edition was published, and he states on page 97 that in this country polystyrene "is scarcely used at all" despite his implication on page 62 that it is a more important commercial plastic than vinyl chloride-acetate resin. New and disconcerting errors of fact are introduced in a section on plastics in wartime; e.g., a phenolic plastic capable of withstanding close to 800 deg. F. is reported and plastic gun stocks for infantry are credited with involving the largest plastics tonnage in the U. S. defense program. Mr. Simonds' book is interestingly semi-popular in style, comprehensive in coverage and well illustrated, but it still needs a thorough combing of the text to eliminate misleading and erroneous statements. G. M. K.

★ LUSTRON, ITS USES AND MANUFACTURE ARE discussed and pictured in four colors by Monsanto Chemical Co., Springfield, Mass., in its new catalog. The plastics industry will find it a stimulus for new ideas of utilization of the properties of this material. Amusing illustrated diagrams concerning properties will be found in the last two pages.

★ A NEW AND COMPLETELY REVISED CATALOG containing 56 pages has been issued by the Walker-Turner Co., Inc., Plainfield, N. J. It is profusely illustrated and explains in detail the standard line of metal working and wood working machine tools made by this company. Also shown are a number of entirely new machine tools developed primarily for the defense industries. A unique Radial Drill Press, two Polishing Lathes and a Radial machine for cutting ferrous and non-ferrous metals, plastics and ceramics are featured.

Molding Technic for Bakelite and Vinylite Plastics

Published by Bakelite Corp., 30 East 42 St., New York, 1941.

Price $3.50 **224 pages, illustrated, fourth edition**

Preface to Chapter 1 quotes Webster on molding: "To form in or into a particular shape" and rightly states that this simple definition by no means gives a hint of the difficulties besetting the modern plastics molder when he endeavors to form the plastic molding material in a die cavity by application of proper pressures and temperatures into a particular shape, which will possess physical and chemical properties. This volume presents the many problems of the molding material fabricator in detail together with suggestions for the economical production of quality molded pieces. Physically the volume is pleasant and easy to handle. Chapters are clearly indexed for ready reference and, appropriately enough, binding is fabricated from vinylite rigid sheet stock. Last chapter contains valuable tables on plastics, woods, metals and miscellaneous materials. H. S.

Plastics

By V. E. Yarsley and G. E. Couzens

Published by Penguin Books, 41 East 28th St., New York, 1941

Price $.25 **160 pages**

Handy in its pocket-size form and engaging in its portrayal of plastics in non-technical style, this narrative prepared by two engineers prominent in the British plastics industry should be popular with both technical and layman readers in this country. The usual details concerning the raw materials and mechanical processes used in the fabrication of plastics into various articles of commerce are presented for the uninitiated. Matters of a more abstract and philosophical nature are discussed in chapters on "Why Are Plastics Plastic," "Significance of Plastics," and "Plastics and the Future." The publishers have not given the book a physical make-up worthy of its subject, but have made an interesting contribution to the present wave of books seeking to interpret the Plastics Age to manufacturers and public. G. M. K.

★ ANOTHER ISSUE OF "MODERN HYDRAULIC Presses" has been published by The French Oil Mill Machinery Co., of Piqua, Ohio. Several different types of presses are illustrated and among them are a number of molding presses. The booklet gives the prospective customer a comprehensive idea of what type of machine the company manufactures.

★ PERHAPS THE FIRST PUBLICATION OF ITS TYPE has recently been issued in the National Vulcanized Fibre handbook for the laminated plastics industry. It consists of technical and descriptive data on national vulcanized fibre which is invaluable to those men in the industry who are putting the product to work, and to those who may find in its diverse qualities the answer to the practical development of more efficient products.

★ ATLAS VALVE CO., NEWARK, N. J., MANUFACTURers of high-quality regulating valves for every service, have issued a 6-page folder relating entirely to their Campbell Boiler Feed Water Regulator which has no floats, thermostats, generators, links or moving parts. The folder lists 17 reasons why the manufacturer believes it is preferred by engineers.

★ A NEW BULLETIN NO. 1635 DESCRIBING THE GORton Model M-E Munitions Engraver was published by George Gorton Machine Co., Racine, Wis. This 4-page booklet, together with an insert, gives the machine specifications, samples of work with production times; accessories, assembly and lubrication charts, and an actual size work chart which permits a prospective machine purchaser to determine whether or not the job in mind will fit the machine. *(Please turn to next page)*

Ask Columbian about

REINFORCED PLASTICS

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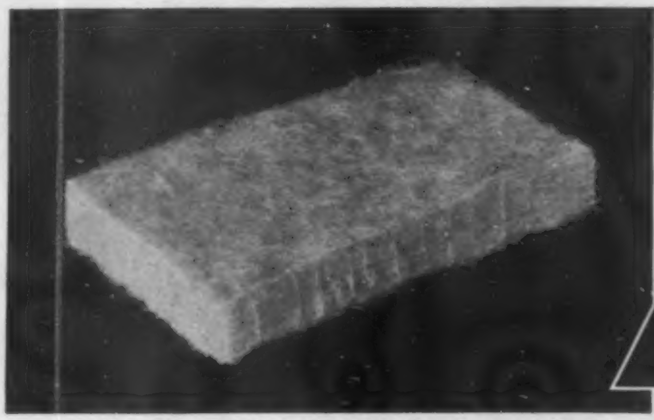
Columbian High Impact Filler



Consolidated mass of fibres (Co-Ro-Felt) prior to application of resin

and

CO-RO-LITE

Resin Impregnated Co-Ro-Felt — ready to mold

A balanced assembly of Co-Ro-Lite prepared for molding bobbin head

The Columbian Rope Company, this country's leading Cordage manufacturers, in their Allied Products Division, are in production on these two outstanding High Impact fillers.

The hard and soft fibres, used for centuries for making strong, durable ropes and wrapping twines have, after several years of research and experimentation, been utilized with complete success as a reinforcing filler in plastics.

In the "Co-Ro-Felt" and "Co-Ro-Lite" processes of the Company, the fillers are used in long stapled length, giving extreme toughness, high impact and shock resistant properties. Both high and low densities are possible in the same molded article by a predetermined assembling of filler sections.

A few of the products now being made from our fillers

PATENT NO. 2,249,888

ALLIED PRODUCTS DIVISION

COLUMBIAN ROPE COMPANY

Auburn, N. Y. "*The Cordage City*"

Chemical Engineering Catalog, 1941–42

Published by Reinhold Publishing Corp., 330 West 42nd St., New York City

Price $3.00 **1 volume, 1214 pages, illustrated**

Twenty-sixth annual edition of the Chemical Engineering Catalog, published annually, includes collected, condensed and standardized data on equipment, machinery, laboratory supplies, heavy and fine chemicals and raw materials used in the industries employing chemical processes of manufacture. Also contained in the catalog are classified indexes of this type of equipment and materials, carefully cross-referenced as well as a technical and scientific Books section which describes briefly and catalogs a list of books published in English on chemical and related subjects. Following its established precedent, Reinhold Publishing Corp. loans the catalog to responsible individuals in the chemical industry for one year. It can be purchased at the end of this time if the borrower wishes to keep it. H. S.

Symposium on Color—Its Specification and Use in Evaluating the Appearance of Materials

Published by the American Society for Testing Materials, Philadelphia, 1941

Price $1.00, heavy paper cover; $1.25, cloth binding

86 pages

This symposium, sponsored jointly by the Inter-Society Color Council and the American Society for Testing Materials, stresses the importance of adequate specifications for color and discusses the use of color in the testing and evaluation of materials. An "Introduction to Color" by D. B. Judd discusses the attributes of colors and the distinction between the psychological and technical definitions of color. Other topics covered and the authors of the papers are as follows: "Color Specifications of Transparent Materials" by F. Scofield; "Hiding Power and Opacity" by R. H. Sawyer; "Color Standards for Opaque Materials" by I. H. Godlove; "Spectrophotometry and Color Evaluation" by A. E. Parker; and "Photoelectric Tristimulus Colorimetry" by R. S. Hunter. G. M. K.

New Encyclopedia of Machine Shop Practice

George W. Barnwell, Editor

Published by Wm. H. Wise and Co., Inc., 50 West 47th St., New York, 1941

Price $1.98 **561 pages**

This guide to the principles and practice of machine shop procedure is based on the editor's experience in training machinists at the Stevens Institute of Technology. The sixteen chapters cover all phases of metal working by modern machinery and were prepared by specialists in handling the various tools. Tables of useful data round out the many helpful features of this book. The quality of the paper suffers somewhat from the publisher's aim to keep the price level low enough to put the volume within the reach of thousands. G. M. K.

★ LAKE ENGINEERING CORP., BUFFALO, N. Y., HAS issued a bulletin describing some of the advantages and advancing developments of molded plastic printing plates. This should be invaluable to all those interested in fine printing since these plates are destined to play a part in the graphic arts industry.

★ THE MOST SOLUBLE DYE YET DISCOVERED FOR solutions in aliphatic and aromatic hydrocarbons—that is the outstanding characteristic claimed for Calco Oil Blue NA in a folder currently being distributed by the Calco Chemical Division, American Cyanamid Company. According to this publication, the dye is extremely versatile in adaptability to the coloring of a wide variety of materials.

★ THE NEW SERIES "S" OF SOUTH BEND PRECISION Lathes, well illustrated with various types of machines, has just been issued in a 7-page catalog. One page is devoted to attachments and accessories which should be of interest to the industry.

★ VIBRATORY MATERIAL HANDLING EQUIPMENT is covered in a 48-page catalog issued by the Syntron Co. which will be of interest to those who need information on vibrators, conveyors, complete feeding machines, constant weigh feeders, packers and jolters, electric hammers, swivel pipe couplings, etc.

★ AMPCO METAL, INC., MILWAUKEE, WIS., PRODUCERS of Ampco Metal, have just issued a catalog describing their Ampcoloy series of bronzes. This new book is well illustrated with photomicrographs, parts and factory scenes. It contains descriptions of the alloys and a comprehensive table of physical properties and range of chemical compositions.

★ NEW FACTS ON HOW LEADING AIRCRAFT PLANTS are meeting their "tooling-up" crisis are revealed in an attractive new booklet, "New Wings for Production," now released by the Delta Manufacturing Co., Milwaukee. Numerous photographs of actual air plant set-ups show some of the secrets of the amazing growth in production capacity of large aircraft concerns. In particular, this booklet emphasizes the clever adaptations of the new type low-cost precision machines—drill presses, cut-off machines, metal-cutting band saws and circular saws.

★ JOHNSTONE ENGINEERING AND MACHINE CO., Downingtown, Pa., in a recently issued bulletin entitled, "Uniform Tension Unwinders with Auto-Hydraulic Brakes," discuss the function and purpose of the machine, together with a description of its various applications.

★ A 48-PAGE PAMPHLET ENTITLED, "FIRE HAZARD Properties of Certain Flammable Liquids, Gases and Volatile Solids," has been compiled by the Committee on Flammable Liquids of the National Fire Protection Ass'n., 60 Batterymarch St., Boston, Mass. This is a revised edition which sells for 25 cents. A series of tables presents a summary of the available data on the tabulated properties of the various substances with indications of the source of information.

★ WHITMAN AND BARNES, 2108 WEST FORT ST., Detroit, have brought out a new catalog of 166 pages which illustrates and lists all types of drills, reamers, counterbores, screw extractors, interchangeable punches, etc., manufactured by the company. It also contains valuable information pertaining to the design, construction, use and care of drills and reamers.

★ FOR NEARLY 20 YEARS, GENERAL ELECTRIC HAS been manufacturing Mycalex, a stone-like product made from mineral ingredients to meet exacting insulation requirements. In order to set forth its features, properties, etc., they issued a bulletin entitled "Mycalex" of 7 pages. The booklet is illustrated with photos and graphs.

★ SEAMFLEX CO., INC., OF LONG ISLAND CITY, HAVE issued two new bulletins, No. 300 and No. 410. The first illustrates standard types of seamless all-metal hose with patented triple seal couplings for temperatures up to 300 deg. F. The second lists standard sizes, safe working pressures, etc.

★ SO THAT THE PROSPECTIVE CUSTOMER MAY visualize the range of Morrison Style B Master Feed Fingers and Pads, Hardinge Brothers, Inc., of Elmira, N. Y., have issued a two-page bulletin with complete ordering information and prices.

Dear Herb Spencer:

Last year you kidded us about a boat - and this year we've got the boat in the competition, a full-sized one made completely of plastics. And we've got the airplane, too. And it took block and tackle and what not to get 'em in but we made the grade.

We've got so much stuff, it'd make your head spin. Come on up and take a look. 6th floor, Chanin Building. Bring your friends and tell the rest. Everyone is welcome.

Charlie Breskin
for Breskin Publishing Corp.

Machinery and Equipment

★ JOHN ROYLE AND SONS HAVE A 6-IN. HIGH TEMperature extruding machine that is used in covering cables on national defense orders. The machine is available in either worm gear or herringbone gear drive, both fully enclosed and self-lubricating. The lands of stock screws are hard surfaced and the cylinder liners are of wear and corrosion resistant material. The insulating head of the machine (shown above) is used with a maximum die size of 2 inches. This means that the outside covering of the rod, tube or electrical conductor insulated can be 3 inches. With a standard "tubing" head, the maximum die size for the extruding of rods, tubes and other round objects would be in excess of 4 in. with some further extension being possible if thin, flat sections were extruded. This machine is one of 8 standard sizes available in Royle extruding machines. Insulating jacket normally used with smaller machines is unnecessary in the larger size. This insulating head is an entirely new development that has found successful application in both rubber and plastic fields. It incorporates a new type of adjustment for centering the wire, or other form to be covered, as well as regulating the amount of stock going into a layer of given thickness.

★ THE DURAFLEX TIME DELAY RELAY BROUGHT out by the Eagle Signal Corp. will control motors, valves, gongs or lights in accordance to a prearranged plan and is ideally suited to be built in as an integral part of the apparatus it is to control. It possesses a 4-inch diameter clock face dial and time set pointer for convenience in making timing adjustments. It also has its own cycle initiating push button which is located in the center of the time set adjusting knob. One of the features of the device is that time settings remain fixed for repeated time intervals until the time set knob is turned to a new setting. The timer can be arranged to hold a circuit open or closed. Ranges are 120 seconds in 1-second divisions and 20 minutes in 10-second divisions in two available models. Units are available in open or enclosed construction for 110 volts or 220 volts operation on 25- to 60-cycle alternating current.

★ BRUCE PRODUCTS CORP. HAS A GROUP OF NEW machines of service for the plastics industry. Among them is the Bruko Model "Ros," a polishing and buffing lathe with a single spindle multi-V-belt drive motor at the rear. The base of the machine is arranged with an overhanging wheel spindle and is cast of heavy section grey iron. The SAE alloy steel wheel spindle is ground to size and is accurately balanced. The spindle ends are machined with flat top threads and fitted with bronze spindle nuts. Each spindle end is tapped and counterbored to permit the assembly of taper point attachments.

★ A NEW VERSATILE TOOL OPERATING ON THE vibrating principle is announced by Burgess Handicraft Supplies. The tool makes 7200 strokes per minute, with stroke adjustable up to 1/8 in., and the uniquely designed chuck easily grips a large variety of engraving needles, cutting knives, gauges and hammers. Special fittings such as depth gauges, etc., make it more widely usable for both craft work and production. The Burgess Vibrotool can be used for engraving, cutting, hammering or carving, on metal, wood, linoleum, sheet rubber, sheet cork and glass.

★ DEFENSE WORK IS AIDED BY A NEW DEVICE brought out by the Cambridge Instrument Co., Inc., now in use and also applicable to industry after the present emergency. It is called the Fabric Permeameter, an accurate, rapid and convenient means for production testing of the permeability of fabrics which are to be inflated with hydrogen, helium, carbon dioxide, etc. Rate of permeation through the fabric is quickly determined by equipment utilizing the thermal conductivity method of gas analysis and is indicated in terms of "liters per sq. meter per 24 hours" of the retained gas.

★ BARBER COLMAN CO. HAS BROUGHT OUT ITS new Barcol Impressor. It is an accurate hardness-tester for aluminum alloys and similar soft metals; plastics, hard rubber and materials of that type. Small and light enough to be carried in the pocket (see photo above), it is always ready for instant use. Only a slight pressure against the surface to be tested gives direct reading on the dial. It may be used in any position—vertically, horizontally or even inverted—thus making it possible to check the hardness of vital points after parts have been fabricated in finished assemblies. The Impressor will prevent costly and dangerous errors by detecting the accidental use of materials which are identical except for hardness.

★ POWERED TO PERFORM SUCH HEAVY, CONTINUous duty work as die grinding at full operating speed and particularly adapted to grinding of fins on airplane engines, the new Thor OOH rotary pneumatic grinder is announced by the Independent Pneumatic Tool Co. Built for operating small grinding wheels the new grinder is extended in the reduced diameter of the spindle support to answer requirements of small clearances and assist in clearing obstructions. (*Please turn to page 122*)

IN THE LIMELIGHT

★ A MOST SIGNIFICANT MEETING OF THE PLASTICS industry took place at the Engineering Societies Building, New York City, on Sept. 25, under the auspices of the Society of the Plastics Industry at which 800 persons, the majority of them SPI members, heard a thorough discussion of today's plastics problem by L. T. Barnette of the Ordnance Department, Office of Production Management. This is the first of a series of technical meetings designed to keep the industry up to date on recent developments throughout the country.

Dr. John Townsend, Material Standards Engineer of the Bell Laboratories, was scheduled as the principal speaker, but illness prevented his address. The committee was fortunately able to persuade Mr. Barnette to substitute at the last minute.

Among the most pertinent of his exceedingly pointed remarks, such facts as these were quick to be discovered: that priorities would soon be abandoned, in the plastics field at least; that allocations would be dealt out to, and by, the materials manufacturers who would be told how much and to whom to sell. Priorities had proved cumbersome, unwieldly, inefficient—and full of loopholes for the unscrupulous, by implication. Industry control is coming, according to Barnette, who minced no words.

He was more hopeful on thermoplastics. While thermosetting materials would bulk larger in 1942, the full production of the materials manufacturers have already been anticipated by growing defense needs, he said. Thermoplastics today, however, are currently absorbed by defense to the tune of 15 percent or 16 percent and the rise would probably not go higher than 25 percent. Rub is, that shortages of plasticizers becloud thermoplastics' sunny picture. To the molders, Mr. Barnette said, in effect: Go after prime contractors and sell them on sub-contracts the same way as you would sell new customers. Don't ask only for the plastics work, try to get them to take plastics substitutes for other parts of other materials. If the parts will work, the government will not cavil at accepting machines with more plastic parts. In fact, the government does not know or care what materials they get so long as the prime contractor is responsible for the efficiency of his equipment.

More than 250 plastics manufacturers are making 450 items a day for defense. Ninety to ninety-five percent of this work is being done on sub-contracts and this appears to be the only hope of the molder. (See page 43 for Mr. Barnette's letter on obtaining defense business.)

Mr. Barnette dealt at considerable length on potential use of certain high impact materials for shell noses, fuze wells and bomb fins. Mr. Barnette called attention to the detailed tests to which these materials are put and the severe service conditions they must withstand. He stated that if certain applications in the Ordnance field particularly for shell noses were approved, and chances are they will be, there would be an unparalleled increase in demand for plastics and a very important release of metals and machine tools which could be otherwise used in defense.

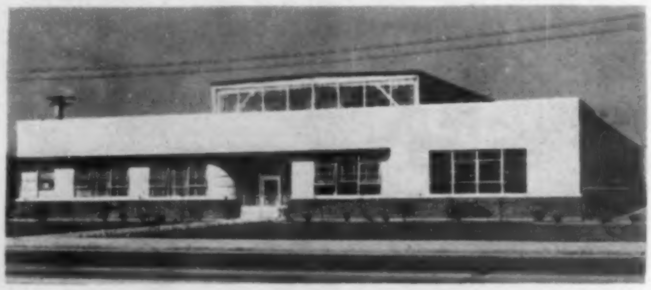
John Adams of the testing laboratories, Bakelite Corp., followed. The gist of his talk was that there is an art to molding that must be mastered if molders are to achieve their full share in materials qualities. He stressed new material development and recent applications for crucial uses—both civilian and defense.

Bombshell of the evening exploded in the person of Leonard Weiss, Research Department of the Brewster Aircraft Corporation, who tongue-lashed with many a quip and smile the plastics industry for their various defects. "I want to use plastics," he said. "I am there 'all the time.' You come to me with usable ideas and I will use your services." Core of Mr. Weiss' plaint was that plastics manufacturers showed little initiative, gave him little help. Also, that prices were out of line with services rendered today.

Ronald Kinnear, President of the Society of the Plastics Industry, informed the assembled group about the SPI Fall meeting at the Westchester Country Club, Rye, N. Y., October 12, 13 and 14, at which the following will speak: A. E. Petersen, Consultant, Priorities Div., Chemical Branch, Office of Production Management, Hon. Bruce Barton, J. B. Johnson, Chief Materials Laboratory, Army Air Corps, and Lawrence Brown, Chemical Branch, Office of Price Administration, Office of Production Management. This will be a vitally important gathering.

★ THE PLASTICS INDUSTRY IN THE MIDDLE WEST conferred on the OPM Formaldehyde Order at a meeting at the La Salle Hotel, Chicago, Tuesday, September 30. A. E. Petersen, Consultant, Priorities Div., Chemical Branch, Office of Production Management, was the principal speaker. Elmer Maywald, of Chicago Molded Products Corp., handled the arrangement details for the Society of the Plastics Industry.

★ THE MERGER OF THREE COMPANIES ENGAGED in the manufacture of molded plastic compounds and the formation of a corporation to carry on the production of these compounds for use in construction of aircraft bodies, completed aircraft and marine and industrial structures was announced this month from the office of Arthur E. Pew, Jr., vice-president of Sun Oil Co. Mr. Pew and his associates hold the controlling interest in the new concern, Universal Moulded Products Corp. Consolidated companies are Monocouple Aeroplant and Engine Corp., Bristol Aircraft Corp. and Bristol Aircraft Products, Ltd., of Canada. The new corporation will have executive offices at 570 Lexington Ave., New York City.



★ RÖHM & HAAS CO., 222 W. WASHINGTON SQUARE, Philadelphia, manufacturer of acrylic resins, recently opened a new plant in Los Angeles, Cal. (above). The plant is primarily equipped to fabricate acrylic resin sheets for the aircraft industry. Inasmuch as there are a number of large airplane manufacturers in Southern California, this would be an important service to them. Perhaps no plastic material plays a more important part in the construction of combat military aircraft than the acrylic group. The plant only occupies a very small portion of the site which the company purchased. Provision has been made for extensive expansion when that may become necessary for increased production.

★ H. R. HUSTED, FORMERLY OF AMOS MOLDED Plastics, Edinburg, Indiana, is now with Zenith Plastics, Inc., Cleveland, Ohio, manufacturer of vacuum cleaner parts.

★ NEW OFFICES AND PLANT OF CROASDALE AND DE Angelis is now located at Eagle and Lawrence Rds., Haverford Township, Delaware County, Pa.

★ A NEW DIVISION HAS BEEN CREATED AT THE Celluplastic Corp., Newark, N. J., for the extrusion of all types of thermoplastic materials in tubing, rod, thread, tape, webbing and strips in continuous lengths, or cut to size. Manufacturing space will occupy 75,000 sq. ft. of the present plant.

★ CURVLITE PRODUCTS, INC., ANNOUNCE REMOVAL of its factory to Port Chester, N. Y., where, with larger facilities, business will go on as usual. *(Please turn to next page)*

★ N. C. HYMAN HAS BEEN MADE VICE-PRESIDENT IN charge of sales of the Erie Plastics Co., Erie, Pa., with offices at 162 Madison Ave., New York.

★ CONSOLIDATED MOLDED PRODUCTS CORP., Scranton, Pa., announces the appointment of D. Gordon Wilson and Co. as its sales representative, with headquarters in Chicago. They will cover Illinois, Indiana, Missouri and Wisconsin.

★ IN ORDER TO ASSIST INDUSTRIAL DESIGNERS, architects, manufacturers and contractors in meeting some of the problems created by the national defense program, New York University has scheduled a series of 15 weekly lectures on modern metals and plastics this fall. Among the speakers slated for the series are Milton Male, research engineer of the United States Steel Corp., F. L. LaQue and J. W. Sands of International Nickel Co., and R. V. Boyer of the Plastics Division, General Electric Company.

KENNETH N. ATWATER

★ KENNETH NELSON ATWATER, FORMERLY WITH Röhm and Haas Co. of Phila., has been appointed General Manager of the Plastics Division of the Prophylactic Brush Co., Florence, Mass. He was associated with the Celluloid Corp. for 9 years, and has also been with American Cyanamid Co., as General Manager of the Plastics department.

★ TENSOLITE CORP., TARRYTOWN, N. Y., ANnounces the organization of its first subsidiary, Tensylon, Inc., with offices and mill located at Eldred, N. Y. They have been sublicensed to make and sell generally round plastic yarn, either solid or covered, except covered wire and rubber. It is also licensed to sell to the textile and allied industries, the crushed yarn product of the Tensolite Corporation.

★ E. W. HOWARD HAS BEEN APPOINTED SALES manager of the Plastics Div. of the Firestone Rubber and Latex Co., Fall River, Mass.

★ IN ORDER TO MEET THE GROWING DEMAND FOR skilled workers in defense and domestic industries, Continental Machines, Inc., of Minneapolis, Minn., have started the Doall Trade School in that city. The training is free to those trainees selected to work on Doall machines. Courses run from 1 to 3 months in machine tool operation. Working conditions will parallel as nearly as possible those of modern industrial plants. At present 15 men are receiving training and it is expected that 30 will be enrolled shortly. Trainees will be selected locally and also from industrial plants throughout the country.

★ THE "BAKELITE" PLASTICS TRAVELCADE HAS been reinstalled in The Franklin Institute, Phila., and is now open to the public. This dramatic exposition of modern plastics for modern living just has completed a three months' stay at the Buhl Planetarium and Institute of Popular Science, Pittsburgh, and prior to this was installed for a period of 6 months at the Chicago Museum of Science and Industry. It brings to the public the fascinating story of modern plastics in a dramatic form that does not require technical knowledge for a clear understanding. The Travelcade is sponsored by Bakelite Corp., unit of Union Carbide and Carbon Corp., and is designed to acquaint the public and industry with the countless ways in which plastic materials are serving in daily life, both in the home and as vital parts in gigantic industrial machines which produce America's manufactured goods.

★ GORDON SCHMELTER, FORMERLY OF DOW Chemical Co., is now chief chemist in charge of Research and Chemical Control at Nixon Nitration Works. He will make his headquarters at Nixon, N. J.

★ THE DEPARTMENT OF CHEMISTRY, McGILL UNIversity, Montreal, will offer its fourth consecutive evening extension course this month on the Chemistry and Technology of Resins and Lastics. Starting about the middle of the month, the course will run for 16 weeks and will cover, as far as time permits, the theoretical chemistry and practical technology of synthetic plastics, coating resins, fibers and rubbers. Instructor will be Dr. R. V. V. Nicholls, assistant professor of Chemistry and secretary of the Quebec Rubber and Plastics Group, to whom inquiries should be addressed.

★ THOMAS R. SMITH, OF THE VULCANIZED RUBBER Co., has recently been appointed manager of the Plastics Sales Division of that company. Mr. Smith had formerly been a salesman of injection molded plastics.

★ PIERCE PLASTICS, INC., BAY CITY, MICH., ONE OF the first molders to successfully extrude polystyrene, is now prepared to quote on furnishing tubing and special shapes of Lustron polystyrene. Tubing can be made to specifications in diameters from $^3/_4$ in. to 1 in. O.D., and special shapes up to 4 in. wide. A drawing of the required cross section, showing allowable tolerances, should be submitted in asking for quotations. Nominal charge is made for special samples which are ordered in addition to regular die charges.

★ AMERICAN PLASTICS CORP., 225 WEST 34TH ST., New York, is producing shapes, profiles, strips, tubes, etc., by continuous extrusion from thermoplastic materials.

★ SYNTHETIC MOULDED PRODUCTS, INC., WAKEfield, R. I., have expanded their plant and opened a new building.

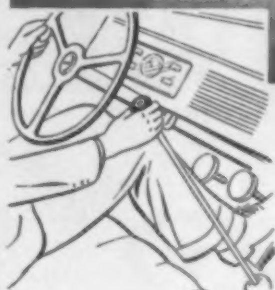
★ GEORGE MARSH, FOR FIVE YEARS A MEMBER OF the well known industrial design partnership of Alcott, Thoner and Marsh, is now (since the dissolution of the partnership) with the Associated Industries of Massachusetts, and will continue to serve his clients as design counsel.

Sorry!

★ IT WAS INCORRECTLY STATED IN OUR SEPTEMber issue that the impeller of the Olivette Acid-Handling Pump, manufactured by Oliver United Filters, Inc., consisted of a resilient sleeve, split gland and lantern ring. They are not part of the impeller, but separate parts made of plastics.

★ ON PAGE 45, SEPTEMBER ISSUE, IN DESCRIBING the Union Pacific new Pullman car "Hollywood," credit was omitted to Industrial Arts, Inc., Chicago, who fabricated decorative Plexiglas plants and other acrylic furniture parts, and to Röhm & Haas, material supplier.

GEAR SHIFT BALL BY SINKO



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1—Plastics division of the General Electric plant at Taunton, Mass. 2—Monitor type construction is used in the Compression Press room, which is 515 ft. long by 100 ft. wide. Tremendous range in press size permits handling of practically all types of routine compression molds. All presses of given capacity are grouped to facilitate production

General Electric's new molding plant

THE General Electric Co. has taken over its Taunton, Mass., plant, idle since 1920, for the production of plastics in order to relieve pressure of a heavy defense program plus the usual industrial work. This constitutes their fifth unit devoted to production of plastics.

Production was started on June 1, just 90 days after the plant was authorized, which establishes a record for installation and construction. The plant site consists of 233,400 sq. ft., or 5¹/₂ acres of land area, with 5 buildings having a total floor area of 88,853 sq. ft. Although many changes had to be made in the old plant before it was suitable for work it was basically correct for molding operation because of its monitor type construction.

Main press room

This room is 515 ft. long by 100 ft. wide. Our own Navy's large new battleship, *North Carolina*, is 729 ft. long with a beam of 108 ft., which gives one an idea of size of the press room. To facilitate handling tools and equipment there are 3 overhead cranes, 2 electric and 1 manually operated which work with a full sweep over the entire length of the room.

The compression department includes 262 presses. These range in size from 9 tons to 565 tons. Range in press size permits handling practically all types of routine compression molds.

The installed high pressure for operating presses is 2500 lbs. The low pressure is 500 lbs. The heating medium is steam which is supplied by the Taunton municipal system. In order to facilitate production, all presses of given capacities are grouped. While this is a deviation from general practice it will assist the handling of production. All of the return lines and drain ducts are embedded in the floor.

Urea-formaldehyde molding will be done entirely in an enclosed protected area, thus protecting the light color shades of these materials from dust and contamination from the air.

Thermosetting powder storage

Thermosetting molding compounds are stored in 2 places. A separate room, immediately joining the main press room, will hold materials for current use. Preforming will also be done here. A duct control exhaust system keeps the air clean. The main thermosetting compound storage, in a separate building, will easily store 500,000 lbs. of material.

Injection department

All of the G. E. Company's injection molding is concentrated at the Taunton plant constituting one of the largest in any American custom molding plant.

It is installed in a large well-lighted room about 88 ft. by 75 ft. in size. Equipment, including 17 machines, was installed in less than three days although it was transported over 150 miles. Various types of stamping and marking equipment are placed in proximity to the injection presses for handling certain decorating and stamping. A screw type extrusion machine is in place for processing thermoplastic materials.

Thermoplastic powder storage

Current issue thermoplastic compounds to handle scheduled injection production are stored in a room adjacent to the injection department. Two sizes of grinders are provided to regrind materials. In addition, a magnetic selector is part of the thermoplastic division equipment. Reground material is passed through this to remove any possible metal contamination which would damage molds.

Ample electrically heated ovens are also provided in this room for drying and conditioning materials for molding.

Paint room

A unique feature of the plant is an especially designed room for painting injection molded parts. In operating the room it will

be kept under constant air pressure as a positive control against dust and dirt. As an additional precautionary control both entrances are made through air lock vestibules. The room will have four spray booths, all of the water washed air exhaust type. In addition to permitting perfect execution of the most delicate decorating and painting, this arrangement is ideal from the point of view of an operator's health.

Finishing and shipping

Obviously, considerable thought has been given to this section. Here are approximately 12,000 sq. ft. of space compactly arranged for concentrated minimum lost motion finishing operations. The Island method of arrangement has been used here. Operators are seated around the outside of the benches on which are placed the necessary manual and mechanical finishing tools. Benches are arranged in oblong position. All articles and parts for finishing are handed to the finishing operators by a supply attendant who stands in the center. He also handles replacing tools and attends to other duties such as moving finished parts along to the shipping department. Buffing and polishing is handled in a straight line operation situated along the long wall of one side of the room.

Fluorescent lighting augments the natural daylight in the finishing room, giving an abundance of excellent light. It is estimated that at every finishing operator's station there are 100 foot candles of light.

Pressure system

The company obtains electric power, city water and high-pressure steam from Taunton, which has a municipal lighting plant of which the steam is a by-product.

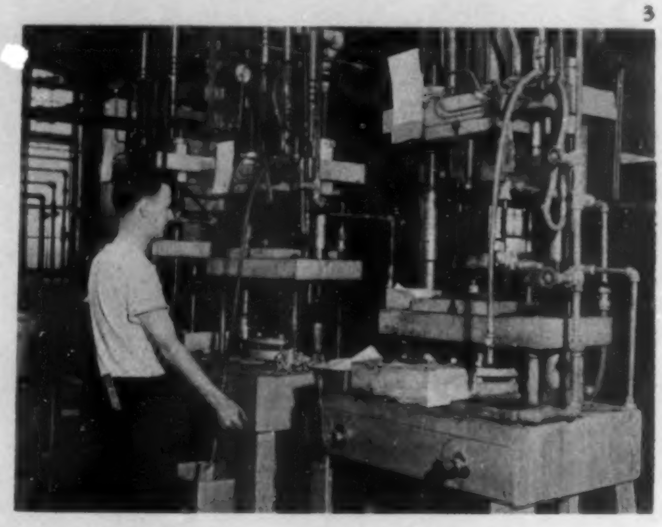
Hydraulic power is obtained from 2 Worthington pumps rated at 70 gallons per minute, 2500 lbs. per square in. pressure, for the molding presses. This is augmented by two Goulds pumps rated at 100 gallons per minute, 500 lbs. per sq. in. pressure used as a pre-fill for the high-pressure hydraulic system.

Air pressure is supplied by a Sullivan V-Type compressor rated at 760 cubic feet per minute at 125 lbs. pressure. This is used for the auxiliary mold members and a variety of other uses throughout the shop.

The accumulator is an Elmes Air-Ballast type of 40 gallons capacity, the air pressure being maintained at 2500 lbs. per sq. in. by the use of a Rix Air booster pumping directly into the chamber.

With the Taunton plant in production, G.E. is rapidly assuming its full share of the defense burden. It is, furthermore, an important peace-time addition to the industry and is a splendid tribute to the capabilities of the men and the company who have directed its construction.

3



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3—Close-up of typical small size compression press installation. 4—A view of one of the industry's largest injection molding departments with a partial view of the injection line. 5—Finishing and shipping room where Island method arrangement of workers facilitates production. Artificial fluorescent light augments daylight, giving 100 ft. candles of light for each operator's station

Detroit unveiling

(*Continued from page 42*) stamping. A choice of 7 mottled shades of acetate trim is offered the consumer, and the trim flows from the instrument panel along the window garnish rails of both front and back doors. A second narrower trim is placed halfway down each door interior. In plain colors these are extruded, but since it is impossible to obtain mottled effects with this method, the strips are injection molded when mottling is desired.

15—Twofold purpose headlight shield and fog lamp which illuminate the roadway and, by means of a reflector (in hand), flash back to the driver showing him lights are lit. 16—An array of stamped hardware decorated with molded plastic trim supplants parts formerly made of chrome plated dye cast metal

15

16

Among the interesting new wrinkles developed this year are the molded fluorescent acetate indicator needles and "hands" on the Chevrolet speedometers and clocks. Then Hudson has designed a knob for their window regulators with a guard to prevent scraping knuckles and tearing fingernails during adjustments. Hudson also boasts edge-lighted acrylic instrument dials controlled with a rheostat.

Still noticeable by their absence are further exterior applications of plastics. Molded acrylics appear on many hood ornaments—as usual. The new Buicks boast molded methyl methacrylate directional lights on the front fenders, also tail light lenses and a reflector-nameplate on the rear. Some engineers express a reticence to use plastics externally, while both Chrysler and Hudson contemplate a great many changes in that direction before the end of '42. Metal-plated thermosettings are under consideration, as are molded laminates. Exterior door hardware, hub caps, extruded exterior trim, even the upholstery on convertible models, are possible developments in these laboratories, which are preparing to meet each crisis as it comes up with a newer, more interesting and perhaps better material than its predecessor. One company is already planning to replace its die-cast identification crest on the trunk door with an acrylic medallion reverse-painted by the See-Deep process. This same process is found on nearly every horn button this year—and acetate steering wheels continue in popularity, one car using an injection molded wheel in one piece on all its models.

In all, these new models mark only the beginning of an interesting year for plastics in the automotive field. The contemplated changes, if they are to come, depend solely on the pinch in other materials and the ability to obtain the required plastics when that pinch arises.

Acknowledgment

The editors wish to thank the automobile manufacturers mentioned in the story for their help in supplying the necessary facts, figures and photographs which contribute to a comprehensive article. Acknowledgments also to plastic material manufacturers, laminators, suppliers and molders (too numerous to mention) who share plastic developments equally today in the automotive industry.

Finishing by wet sanding

(*Continued from page 51*) finishing molded plastics by these methods are manifold. In the following discussion, basic principles and advantages of wet sanding will be covered generally. The accompanying illustrations indicate some specific usages for these waterproof cloth belts.

Sprues, flashings, mold parting lines and slight mold imperfections can be removed with cloth sanding belts economically and the resulting finish after buffing is excellent. For example, when removing the sprue shank from injection molded knobs, handles, vanity cases or numerous other types of thermoplastic articles, the appearance of the products is greatly enhanced by having all traces of the sprue and mold parting lines

CLASSIFIED

FOR SALE: 1—400 Ton Horiz. Hydraulic Extrusion Press. 1—Hydraulic Scrap Baler, 80 Ton, 6½" Ram, 90" Stroke, 5000 lbs. per sq. in. 2—W. & P. Mixers, Size 15. Large stocks Hydraulic Presses, Pumps & Accumulators, Preform Machines, Rotary Cutters, Mixers, Grinders, Pulverizers, Tumbling Barrels, Gas Boilers, etc. Send for Bulletins #156 and #138, and L-17. We also buy your surplus machinery for cash. Reply Box 439, Modern Plastics.

FOR SALE: 1—Birdsboro 20" x 24" platen Hydraulic Press, 20" dia. ram, 29" day., 4" posts with pullbacks; 1—W. S. Hydro-Pneumatic Accumulator 2500 PSI, 8 gal. with IR m. d. air compressor; 12—30" x 40" PLATEN, 500 ton Hydraulic Presses; 1—W. S. 15" x 18" Hydraulic Press, 9" dia. ram, 4" posts; 1—W. S. 24" x 48" Hydraulic Press, 12" dia. ram, with hydraulic pushbacks; 1—46" x 54" Hydraulic Press, 19" dia. ram; 1—Thropp 36" x 36" 4-opening Hydraulic Press, 12" dia. ram; 1—Bethlehem 38" x 78" Hydraulic Press, with 20" dia. ram; Birmingham 16 x 36 Mixing Rolls, silent chain 40 HP drive; 1—Allen 16" x 42" Rubber Mill; 7—W. & P. Mixers; 1—Stokes "R" Pill Machine. Send for Complete List. Reply Box 446, Modern Plastics.

WANTED: Stainless Steel or Nickel Kettle, Vacuum Pan, Hydraulic Press, Preform Machine and Mixer. Reply Box 275, Modern Plastics. No Dealers.

2 OZ. H-P-M INJECTION MOLDING MACHINE FOR SALE—Model #54, in excellent condition. Address Box 433, Modern Plastics.

WANTED: Chemical Engineer with Plastic Experience. Preferably with Ph.D. and Research experience in making and molding urea formaldehyde resins. The position open is in the development field and offers excellent prospects. Location Eastern Canada. Give detailed information regarding education and experience to which photograph must be attached and will not be returned. State salary expected. Reply Box 466, Modern Plastics.

WANTED: Injection Molding Acetate Scrap or Rejects in any form, including Styrene, Acrylic, Butyrate, Vinyl Resin Scrap materials. Submit samples and details of quantities, grades and colors for our quotation. Reply Plastics, 141 Halsey St., Newark, N. J.

WANTED: PLASTIC SCRAP OR REJECTS in any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic, Vinyl Resin, etc. Also wanted surplus lots of phenolic and urea molding materials. Reply Box 318, Modern Plastics.

EXPERIENCED ENGINEER, on Reed-Prentice Injection Molding Machine. And 3 yrs. experience as a Factory Manager. Reply Box 469, Modern Plastics.

WANTED: Experienced extrusion machine operator. Excellent opportunity with new southern concern. Compression molding experience desirable but not necessary. Pléase state qualifications and salary desired. Reply Box 470, Modern Plastics.

WANTED: Experienced foreman and experienced workers on Reed-Prentice Injection Molding Machines. Reply Box 471, Modern Plastics.

FACILITIES AVAILABLE FOR CASTING small hard steel dies for hobbing. Immediate delivery. Reply Box 472, Modern Plastics.

CANADIAN COMPANY with own plant specialising in plastic compression moulding is interested in close collaboration and possibly merger with, or participation in, similar American or Canadian concern for the purpose of complementing production. Ready to make additional investment. Reply Box No. 473, Modern Plastics.

WANTED PRODUCTION MANAGER by compression moulding company in Eastern Canada. All round experience required. High salary. Write Box No. 474, Modern Plastics.

WANTED—Reed-Prentice Injection Molding Machine. State size and model number. Scrap grinder Cap. 150 lbs. per hr. Reply Box 475, Modern Plastics.

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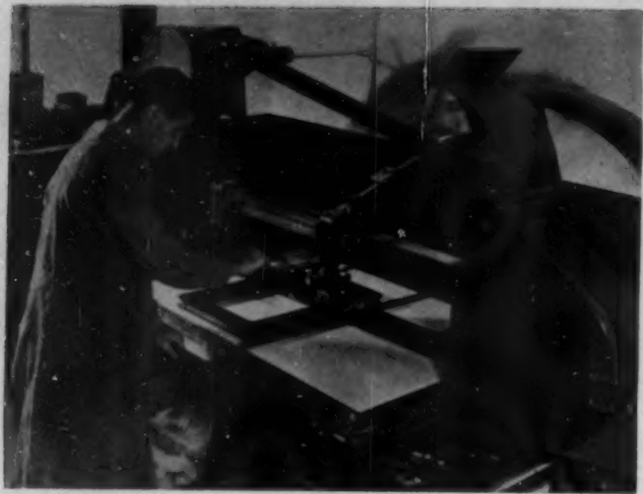
manufacturing medium and heavy machinery, having highest financial rating, has retained us to investigate and recommend to them propositions of merit for manufacture as soon as existing demands through defense priorities make this possible. Particularly interested in new processes or unusual machinery or products having exceptional marketing possibilities. Assistance such as research, engineering, etc., might be furnished if essential. Propositions submitted will be considered confidential. Barkley Associates, 131 Clarendon St., Boston, Mass.

HIGHEST PRICES PAID FOR PLASTIC SCRAP OR REJECTS, any form, Cellulose Acetate, Butyrate, Polystyrene, Acrylic and Vinyl Resins. Also Phenolic and Urea molding materials. We do Custom Grinding and Magnetizing. Reply Box 476, Modern Plastics.

COLLEGE GRADUATE IN CHEMISTRY with special studies in plastics desires position with plastic manufacturer, molder or fabricator. Salary no object. Reply Box 477, Modern Plastics.

WANTED—One Reed-Prentice 4, 6 or 8 oz. injection molding machine. Reply Box 478, Modern Plastics.

WANTED two or four ounce used, but in good condition Injection Moulding Machines, 220 volts, 25 cycle, 3 phase. CANADA. Reply Box 479, Modern Plastics.



Sanding lines are removed by buffing with a mild cutting compound and dry-buffed with a canton flannel wheel for coloring, as pictured here

removed. One large plastic fabricator has announced that their operators remove sprues and parting lines from automobile window crank knobs at the rate of 2150 knobs per hour with a sanding cloth belt, the dimensions of which are 120 in. by 3 in. It is hard to control the cutting action of a cutting compound used on a polishing wheel and a good clean job cannot be accomplished with trimming knives. The ordinary type of dry coated abrasive will not do a satisfactory job because frictional heat generated in dry sanding thermoplastic materials causes plastic flow or burning, and the abrasive cutting surface rapidly fills up with abraded stock. Waterproof cloth belts, disks or sleeves used with water remove stock rapidly and the cutting action is clean and cool. An added advantage in using water with waterproof sanding belts is that finer grades of abrasives can be used, which reduces polishing time on buffing wheels when the finished article is color buffed manually or automatically.

Most finishing operations on cast resin pieces or thermoplastic molded items can be accomplished with one wet sanding operation using an appropriate grade followed by one buffing operation. Where an excessive amount of stock is to be removed, it is better to use a two-step wet sanding operation in order to speed up production and obtain the maximum efficiency from the sanding cloth belt, disk or sleeve. In such cases the first operation would be accomplished with a coarse grade, followed by a finishing operation with a finer grade of sand.

To obtain maximum yield and satisfactory finishes on the various types of molded plastic articles with the cloth belts, the belts should travel at 2500 to 3000 surface feet per minute and a sufficient amount of water be played on the belt directly above and below the working area. Thus adequate lubrication and cleaning are assured.

In finishing compression molded thermosetting plastic pieces, waterproof sanding belts or disks can be used with water, or dry. Coarser grades of abrasive can be used, as this type of molded part will not show sanding lines as readily as thermoplastic molded articles. In many cases a single sanding operation with a fine grade will remove flashings or square up a base satisfactorily. On rougher work one finishing operation with a coarser disk or sleeve will suffice. Waterproof cloth belts or disks can be used with water or dry for finishing compression molded articles as there is no plastic flow, burning or belt loading. The chief advantage in using water is the fact that dust, which is objectionable and hazardous, can be eliminated. Due to the characteristics of the synthetic abrasive bond of the cloth, the yield per belt or disk is four to five times greater than can be obtained with a comparable grade of abrasives designed only for dry sanding.

Many machine manufacturers are now selling or have designed equipment especially for wet sanding operations which will handle a great variety of jobs. A narrow flexible waterproof cloth belt as illustrated in Fig. 1 will conform to many irregular shaped articles that require profile finishing to remove mold parting lines or flashings. Flat work can be squared up with waterproof cloth belts operated over a metal platen or with abrasive cloth disks cemented to a flat steel face plate. In order to prevent excessive "bumping" of the belt splice when passing between work and metal platen, it is advisable to cushion the shock of splice passing work by placing a piece of rubber, canvas or cork over platen; and to cover rubber with 20-gage phosphor spring bronze so that the light metal over rubber cushion is in contact with abrasive belt backing.

Since the advent of flexible-backed coated abrasives that can be used for dry or wet sanding, it has been possible to eliminate many slow hand finishing operations. Waste has been reduced to a minimum because defects in molded parts can be repaired with wet belts and the original mold finish restored.

High voltage resistors

(*Continued from page 62*)

The plastic material used was selected for its ability to stand extreme changes of temperature and humidity without cracking or checking and to have a high electrical resistance at elevated temperatures.

The resistors as they come from the mold are complete, calibrated units. They can be operated at ambient temperatures of 100 deg. C. and then immediately placed in a dry ice chamber, without damaging the unit or permanently changing its resistance. They can be alternately placed in hot and cold salt solution without penetration or damage. They are not affected by most acid fumes.

The units are made in values of $^1/_4$, $^1/_2$, $^3/_4$ and 1 megohm, for voltages of 250, 500, 750 and 1000 volts. They are intended primarily for D-C use, but are non-inductively wound and may be used on frequencies up to 1000 cycles. The units are $1^1/_4$ in. in diameter and

3-Illustration shows 3, 5 and 8 kilovolt sectional resistors with end ferrules

1.4 in. long. They are usually mounted on insulating bushings by means of fuse clips, but single units may be fastened directly to a terminal of an instrument.

Perhaps the outstanding feature of this resistor is the flexibility of different ranges. Each resistor can be used by itself or with any number of associate resistors, merely by screwing together the desired number. No wiring is needed, no insulation of leas, and there are no exposed bare wires. As many as thirty units, for 30,000 volts service, can be used in one string where they form a rod $1^1/_4$ in. in diameter and 42 in. long.

The use of molding material has made possible the carrying through of the unit idea in the resistor. By making each separate resistor a complete unit, they can be built up into any combination or value of voltages needed by the simple method of screwing them together. This has greatly simplified the stocking problem as only four values are needed for any usual combination of voltages. It has increased its value to the user as he can change the number of units to fit his needs or take taps off at any point on the resistor string. In case of damage a unit can be replaced without losing the whole sectional resistor.

Credits: Laminated Micarta by Westinghouse. Molding job by Shaw Insulator Company.

Creep and cold flow of plastics

(*Continued from page 79*)

A further advantage of the beam deformation test is the ease with which data are obtained to measure the modulus of elasticity. It is already a well-known fact that such calculations are difficult to obtain from stress-strain curves of tests upon plastic materials. It is well known that moduli in tension and compression are not the same for plastics, there being about 50 percent difference in many cases. Consequently structural designers must make use of broad assumptions in applying the figures to their calculations. However, data obtained under conditions more comparable to the structural loads involving simultaneous tension and compression, would be more directly applicable.

The resin bonded veneers behave very well as compared with plastics in creep and cold flow. However, the effect of greater bonding pressures may be noted in Fig. 13, which undoubtedly affect adversely the wood structure so that greater creep ensues. This would not necessarily be the case for fully resin-impregnated wood veneers where physical loads are carried by synthetic resin structure rather than the cellulosic structure.

In conclusion, we wish to reiterate the importance and usefulness of the short time creep tests as a means for making rapid comparisons of materials. It may be further concluded that thermoplastics in structural applications above 85 deg. F. should be viewed with a great deal of caution, because while physical constants such as the moduli of elasticity and tensile strength do not change much, the creep does, excessively so.

[1] Burns and Hopkins, Modern Plastics *14*, 42, Aug. 1937.
[2] Penning and Meyer, Modern Plastics *17*, 91, Nov. 1939.
[3] Delmonte, Trans. A.S.M.E. *62*, 513, Aug. 1940; Modern Plastics *17* 49, May 1940; 65, June 1940.
[4] Marin and Zwisslen, A.S.T.M. Proc. *40*, 937, 1940.
[5] Bartoe, Mech. Eng. *61*, 892, Dec. 1939; Modern Plastics *17*, 47, Mar. 1940.

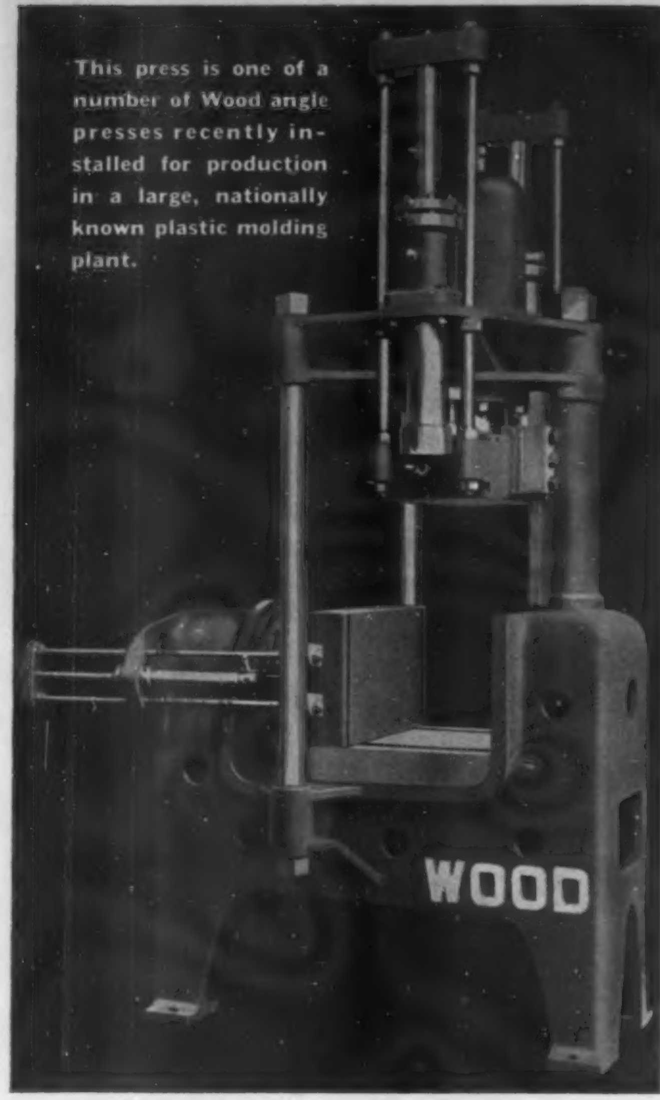
Twin-motored plastic plane

(*Continued from page 53*) are applied. Between each layer of wood plastic, resin in solution is sprayed or painted on.

2. Molding—Fuselages, wings, spars or other parts built up in this manner are then placed in a rubberized bag. Next, the bag is deflated by using a vacuum. Placed on a rack in the rubberized bag the parts are cured in a steam jacketed tank using heat and pressure. These are varied depending upon the sizes of the parts and the type of plastic. The length of cure is also determined by the material and size factor. The steam pressure inside the tank, exerted on the entire surface of the parts being cured, supplants the female die of conventional powder mold. It assures an absolute even pressure distribution. When the parts are removed after curing they are ready for assembling with only a minimum amount of finishing.

Pilots and aircraft designers realize the ever present fire hazard in engines. There was some doubt that the material would be appropriate for engine nacelles but after engineers had studied the problem they developed a product which serves most satisfactorily. As a test, engines were run in plastic plywood nacelles steadily for three days without any noticeable adverse effect. Some of the fire-resisting plastic plywood has a layer of asbestos laminated to the plies. In service they have established a flawless performance record.

Parts made with the Langley process hold dimensions very well. This is demonstrated by the following edge of the elevator which hasn't a wave or surface undulation in it. These dimensional characteristics are also noticeable in the ailerons. Aerodynamic advan-



...WOOD ANGLE MOLDING PRESSES

Units like the one shown above, as well as other WOOD presses in a variety of sizes and capacities, play important parts in the production of molded plastics.

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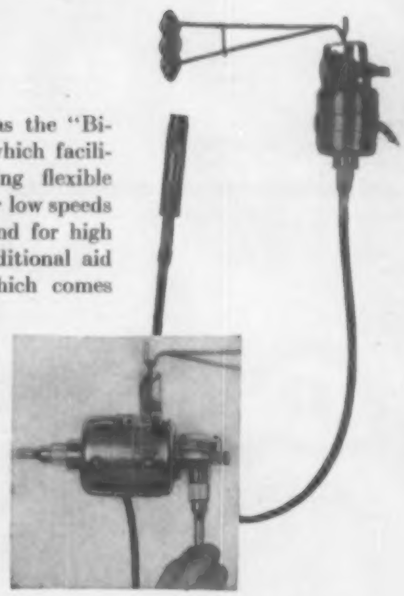
IN these days of "RUSH ALL ORDERS," industry faces gigantic tasks. All too often, heavy duty tools are tied up on small die and mould jobs, and many other miscellaneous operations that the Foredom can do so efficiently. Release your heavy duty equipment for big jobs—and use the Foredom instead. Foredom offers the opportunity for more tools in the shop—so that more jobs can be done—yet at a lower equipment investment.

Use Foredom

for grinding, milling, polishing, sanding, scratch-brushing, carving, etc., etc., and, of course, for finishing, correcting and touching up dies, molds, etc.

Model 440 . . .

illustrated at right has the "Bi-Connective" feature which facilitates quickly attaching flexible shaft to geared end for low speeds and to direct-drive end for high speeds. With the additional aid of a foot rheostat which comes with the tool, an extremely wide range of speeds is provided.



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Fine Tools
Since 1922

•

Included in the line are several styles of suspension models which can be hung on any convenient hook or bracket, as well as easily portable bench models as shown at left. Some come with pencil-size handpieces for fine, sensitive control. Five handpiece types are available, all with quick-interchange feature.

The merit of Foredom Tools is definitely established by the experience of thousands of users, many of whom are still using Foredom Tools purchased almost two decades ago. Many well known firms have batteries of Foredom Tools in daily use. They are employed by numerous of the country's largest corporations, by many federal, state and municipal government departments and by famous universities, colleges, schools, institutions, etc.

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tages are also claimed by virtue of the integral skin structure holding its true air foil shape in flight with corresponding increases in the performance of the plane.

Many classes of plastics are used. Among them are vinyl alcohols, urea and phenol resins. Weight considered, the company engineers have favored thermoplastic materials. On the other hand, other characteristics make the thermosetting materials more attractive.

Thus far, the wood used for plies has been Honduras mahogany, exclusively. Because of low cost of materials and a less expensive labor factor, price of the Langley ship is expected to be within moderate range, particularly after the initial engineering and research expenses are written off. No specific price has been announced, although the builders state it will be much lower than the cost of any plane of corresponding utility. The Langley craft can be built as single or multi-engine ships. They are expected to have application in almost every phase of aviation. Builders of the Langley anticipate that their molded aircraft process will be adaptable for military transport gliders commercial or private airplanes or, in larger sizes, for commercial or troop carrying transports.

Color fastness of plastics

(*Continued from page 82*)

Report

5. (*a*) The relative amount of color change of the plastic shall be reported as none, slight, appreciable, or extreme.

NOTE 3.—A slight change is defined here as one which is perceptible with difficulty. An appreciable change is one which is readily perceptible without close examination but is insufficient to markedly alter the original color of the specimen. An extreme change is one which is very obvious and has resulted in a marked alteration of the original color of the specimen.

(*b*) The direction of the color change, for example, lighter or darker, and any other noteworthy effect of the exposure to the light on the appearance or condition of the specimen shall be reported.

From 9 to 5

(*Continued from page 61*) similar in many respects to the molding of actual parts. The test bars provide transverse or flexural strength, impact insulation and cold flow test specimens. The methods used whenever possible are those of the American Society for Testing Materials, which have been found most satisfactory.

Many other tests are given at the laboratories which insure the best possible selection and service from plastic materials. In addition to phenolics, the Bell Telephone System uses acetates, principally for interleaving in coils; acrylics; viewing lenses on designation strips and other optical uses in telephone apparatus; synthetic coatings, for finishes on apparatus for improved

appearance, mechanical and chemical protection of the underlying structural material which is usually metal, and not infrequently for electrical insulation purposes; corrosion protection, insulation purposes and also as adhesives.

Many important applications of plastics have been made in the telephone field. According to the laboratories, they have sprung "from the economies of design, methods of fabrication, as well as from the excellent serviceability of the molded plastic products."

Typewriters and office machines

Although plastics have not yet been extensively used for the typewriter, there are several innovations which have improved its operation and appearance. The Royal Typewriter Co., for example, replaced flat glass disks with concave methyl methacrylate disks for operators' finger comfort. Replacement with glass would have been prohibitively expensive. They are injection molded.

Also of the same material is a transparent plastic typewriter roll introduced by the Lumirol Co.[3] When used together with a special means of illumination offered by the company, it provides improved visibility and convenience in cutting mimeograph stencils. The lighting fixture, attached to the typewriter, contains a tiny 6-watt fluorescent tube. The light, directed toward the roll, is transmitted by the methyl methacrylate. Thus the stencil is illuminated from beneath and each letter, as cut, becomes easily visible, preventing difficult resetting in the typewriter after the complete stencil has been made.

Another important use of plastics is by the Marchant Calculating Co. for its various calculators. Injection molded acetate key tops and bars insure a smooth and easy operation. In a few instances, dials are made in plastics and gears are laminated. Alternate plastic and steel gears are used as far as practicable throughout the machines. The particular laminated plastic used was chosen because of its relatively high resistance to breakage, both under direct load and under shock. Plastic key tops are pressed on to metal stems shaped so that the cold flow of the plastic tends to lock the key top to the stem.

"In our opinion," states Harold J. Avery, chief engineer of Marchant, "plastics far exceed any other material for use in key tops and bars, giving excellent appearance and maintaining that appearance well in spite of much handling and hard usage. The color effects are good and, in the case of key tops, easy to handle and inexpensive."

A distinct aid to the office worker is the "VISIrecord" Divider, plastic tab indexes that replace metal guides. Angled tabs give complete visibility to the worker and smooth edges eliminate the possibility of cuts and scratches. Vinyl sheet is used for the upper strip of the Divider because it does not warp when near steam heat, or curl because of atmospheric conditions. The end rails, formerly made of aluminum, are extruded strips

[3] See MODERN PLASTICS *18*, March 1941, p. 42.

of cellulose acetate in translucent gray. It is lighter than the former material and practically noiseless, an important factor in a busy office. Vinyl strips are used on the top of margins for the "card-out" posting tray. The operator is able to see 5000 cards at a glance, thus making her work much easier. Because all the bulk of the card guide is entirely above the body of the guide, no more thickness in indexing material is required than the small thickness of the pressboard used.

Long enthusiastic user of plastics is the Ediphone Division of Thomas A. Edison, Inc., in the manufacture of their dictating equipment, the Ediphone. According to Mr. Rod Fuller of that organization, molded phenolics were selected because of ease of fabrication.

"For our purpose," said Mr. Fuller, "it is desirable to have a material typifying cleanliness. With plastics the effect is realized by molding with clean-cut lines, together with lightness and a softness and pleasant feeling to the touch not obtained by any other material. We also find plastics satisfactory because they do not take the heat from the hand as rapidly as metal."

Two applications of plastics are made in the manufacture of the Felt and Tarrant comptometer: key tops of acetate and motor ends of molded phenolic. Acetate was selected for the key tops because the figures can be molded as an integral part of the key top and because the material itself is non-inflammable and colors attractive. On the Model K Electric Comptometer, the motor ends are excellent examples of intricate precision molding. Specifications covering them call for strong, light, molded parts with openings in 6 directions; permanently anchored inserts in both horizontal and vertical planes; for bearing and assembly holes so absolutely concentric and exactly located as to insure perfect alignment of bearings after assembly.

Whether it is a minor application on a typewriter or the various and intricate moldings for the telephone, plastics undoubtly help the American businessman to maintain a smooth, well run and efficient office.

Credits: Bakelite, Lumarith, Tenite, Resinox, Auburn Button Works, General Electric Co., Bell Telephone Co., Felt and Tarrant Mfg. Co., Visible Index Company.

Processing pyroxylin sheet

(Continued from page 69)

7. *Blanking:* An operation that often requires the use of heavy duty power presses turns out complicated and intricate shapes in sheet plastics. Heavy plastic is blanked out on large punch presses. The lighter materials are blanked by hand on large wooden chopping blocks, and still other thicknesses made require a foot-kick press for the blanking operation. Corners are rounded, holes pierced and slots blanked. Outside shapes are cut cleanly and smoothly by the use of steel dies and punch press equipment. There is no limit to the shape or design that can be blanked.

(Please turn to next page)

8. *Finishing:* Cloisonné is a recent development that brings out the beauty and the old gold cloisonné finish on metal. All of us can remember the beauty of grandmother's watch case. Designs of this nature can now be reproduced on clear plastic and finished with any color of the rainbow. Gold, of course, is prominent because of its richness and beauty, but any color can be reproduced in its true color and there is no limit to the design. Hammered copper can now be reproduced in its beauty and color by decorative plastics.

9. *Assembly:* Operation requiring the use of numerous special machines that will assemble and put together various pieces of plastics that have been produced in different forms. For example, calculating instruments that are eyeletted together in the center require careful assembly. Buttons and badges are assembled in presses that crimp the piece of metal and the plastic covering together in a solid grip. Badges made in this manner, for plant protection, are non-tamper-proof. Hundreds of other advertising specialties, items and industrial pieces are assembled and put together by skilled workers using special equipment.

One of the most interesting applications (Fig. 2) of cellulose nitrate sheet, because of our heavy defense program, is the badges affixed to lapels of workers in defense industries. The photograph plus the identification badge has proved to be the best and most inexpensive method of protecting the plant from saboteurs. The non-inflammable plastic material window makes the badge fireproof and the special clinch-rim makes it impossible to tamper with the contents. Finally, the patented double catch pinlock back with the pin point buried inside the badge, renders it proof against injury and lessens the possibility of loss or theft.

Another important defense application are the aircraft plotters (Fig. 4). Absolute accuracy is imperative and careful printing is possible on a well-seasoned sheet. Also useful are the cellulose acetate dials for radios and automobile dashboards (Fig. 1). The difficult job of accurate scale printing has now been overcome, creating new uses for pyroxylin sheet.

Credits: Nixonoid and Celluloid fabricated by Cruver Mfg. Co.

Molded pulp resin products

(***Continued from page 45***) strength infinitely greater than that of articles made from other general purpose molding compounds. The tabulation gives its physical properties:

Specific gravity ASTM.	1.35– 1.40
Weight per cubic inch. .	22.1– 23.0 grams
Water absorption—24 hours—ASTM.	0.60– 2.00 percent
Bond strength in pounds	1000– 1100 pounds
Impact strength—(notched Izod).	2.50– 4.0+ foot pounds
Fluctual strength ASTM	14,000–20,000 P.S.I.
Tensile strength ASTM	7000– 8000 P.S.I.
Compressive strength. . .	20,000–40,000 P.S.I.

(Please turn to next page)

The enthusiasm with which Kys-ite has been received would indicate that it has a very definite use as a substitute for materials which, up to this time, plastics have not been able to replace because they lacked the necessary strength.

A recent development in the industrial field is the decision of one well-known American manufacturer to substitute Kys-ite for aluminum for many parts in its standard product. This decision was not prompted by the lack of metal alone but because of the added strength and adaptability to the particular type of construction involved. A painstaking investigation was made by the technical experts of this company before reaching a decision and very thorough tests were also conducted by the material supplier on the development of a synthetic resin proper for use in this particular project. The appearance of this product in which Kys-ite is to play such an important part will occur sometime within the next few months. It is expected that the revolutionary nature of its application is almost certain to cause its rapid adoption in many other industries as well as in similar fields.

Interest expressed by countless manufacturers plus the ease with which the material adapted to purposes formerly dependent on metals of various sorts would indicate a very bright future for Kys-ite and, while at the moment this interest is undoubtedly stimulated somewhat by the lack of metal, it is equally true that in many fields it will be found superior for the purpose employed and can maintain its position in competition with other materials after the duration.

Credits: Durez phenolic resins used in process.

Obtaining defense contracts

(*Continued from page 43*)

The addresses of the Contract Distribution Division offices are as follows:

Atlanta, Georgia	104 Marietta Street
Baltimore, Maryland	Lexington and Calvert Streets
Birmingham, Alabama	18th Street and 5th Avenue, North
Boston, Massachusetts	30 Pearl Street
Buffalo, New York	Traders Bank Building, Room 212, Main and Swan Streets
Charlotte, N. Car.	New Liberty Life Building
Chicago, Illinois	230 South LaSalle Street
Cincinnati, Ohio	Union Trust Bldg., Room 804
Cleveland, Ohio	East 6th Street and Superior Avenue
Dallas, Texas	Wood and Akard Streets
Denver, Colorado	17th and Arapahoe Streets
Des Moines, Iowa	505 Crocker Building
Detroit, Michigan	160 Fort Street, West
El Paso, Texas	351 Myrtle Avenue
Helena, Montana	Park and Edwards Streets
Houston, Texas	Texas Avenue and Caroline Street
Jacksonville, Florida	504 Hildebrandt Building
Kansas City, Missouri	Tenth Street and Grand Avenue
Little Rock, Arkansas	Third and Louisiana Streets
Los Angeles, Calif.	Tenth and Olive Streets
Louisville, Kentucky	5th and Market Streets
Memphis, Tennessee	3rd and Jefferson Streets
Milwaukee, Wisconsin	1124—1st Wisconsin Natl. Bk. Bldg.

(*Please turn to next page*)

Minneapolis, Minnesota	240 Rand Tower Building
Nashville, Tennessee	228 Third Avenue, North
Newark, New Jersey	176 Sussex Avenue
New Orleans, Louisiana	Carondelet and Common Streets
New York City	33 Liberty Street
Oklahoma City, Okla.	226 West Third Street
Omaha, Nebraska	1701—5 Dodge Street
Philadelphia, Penna.	925 Chestnut Street
Pittsburgh, Penna.	Grant Street and Ogle Way
Portland, Oregon	Sixth and Oak Streets
Richmond, Virginia	Ninth and Franklin Streets
Salt Lake City, Utah	Corner So. Temple and E. State Streets
San Antonio, Texas	Jardin and Villita Streets
San Francisco, Calif.	Sansome and Sacramento Streets
St. Louis, Missouri	411 Locust Street
Seattle, Washington	National Bank of Commerce Building

The following are Ordnance District offices:

Birmingham, Alabama	1908 Comer Building
Boston, Massachusetts	Room 1501, 140 Federal Street
Chicago, Illinois	Room 222, 309 W. Jackson Blvd.
Cincinnati, Ohio	831 The Engineer Building
Cleveland, Ohio	1450 Terminal Tower Building
Detroit, Michigan	1832 National Bank Building
Springfield, Mass.	95 State Street
New York, N. Y.	Room 1815, So. Broadway
Philadelphia, Penna.	Room 1417, Mitten Bldg., Broad and Locust Streets
Pittsburgh, Penna.	1032 New Federal Building
Rochester, New York	1132 Mercantile Building
St. Louis, Missouri	Room 935, U. S. Custom & Courthouse
San Francisco, Calif.	Room 118, Federal Office Building
Wilmington, Delaware	1466 Nemours Building
Los Angeles, Calif.	409 Chamber of Commerce Building

Machinery and equipment

(*Continued from page 96*)

★ A NEW DRILL GRINDING ATTACHMENT MADE BY Delta Mfg. Co. said to use the face of the wheel, the natural way. A precision built unit is claimed to be simple to operate for a perfect drill sharpening job. A setting attachment with an accurate scale permits micrometer settings that insure evenly ground lips so that the drills run true. The amount of lip clearance on the drill has enough of the heel cut away to provide enough clearance without weakening the cutting edge. It can be adjusted so that each drill can be ground to fit the job with lip clearance and angles at any degree required. Capacity: $^1/_8$ in. to $^5/_8$ in. drills.

★ PRECISION SCIENTIFIC CO. ANNOUNCE A NEW electric stopwatch, known as "time-it" Minute Model, run by a synchronous electric motor which operates a direct reading indicating counter. Accuracy is covered by the cycle constancy of 115 Volt A.C. current supply. The device integrates to 1000 min., reading in full minutes and hundredths of a minute. It can be reset to zero from any reading, or successive readings can be totalled. Applications suggested are laboratory procedures, time study operations, timing of long distance telephone calls and motor dynamometer tests.

★ A SMALL CIRCUIT BREAKER ANNOUNCED BY WESTinghouse Electric & Mfg. Co. is designed primarily for the protection of lighting, appliance and motor circuits in homes, buildings, stores and factories. This circuit breaker is said to introduce a new principle to circuit protection, combining for the first time in a single unit a cooperative magnetic and a thermal trip.

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in meeting rigid government and industrial specifications

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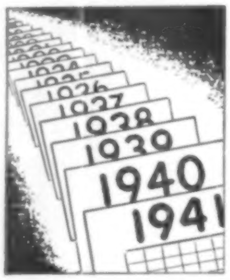
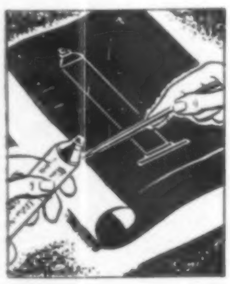
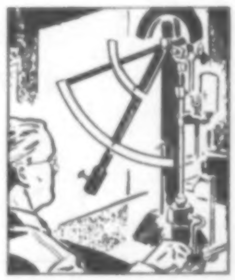


1 MANY YEARS' EXPERIENCE: Many plants are today employing plastics for essential items. To these concerns, Bakelite Plastics Headquarters offers its assistance in meeting exacting government and industrial standards and specifications. Plastics Headquarters is well qualified to help engineering groups in finding the answers to such important questions as the right plastic to use and the correct method of fabrication.

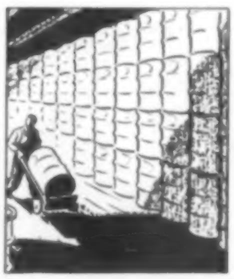
2 FIELD SERVICE REPRESENTATIVES: To assist manufacturers in using plastics correctly, Bakelite Plastics Headquarters maintains a staff of Field Service Representatives. These men are plastics specialists. Long years of experience qualify them to study conditions prevailing in an individual plant, and determine how existing equipment and personnel can be used most effectively to obtain the desired results.



3 ADVISORY TECHNICAL STAFF: By investigation, study, and analysis of a specific plastics application, the Bakelite Advisory Technical Staff is often able to offer ideas and suggestions that will simplify design, speed production, cut costs, and improve product performance. It welcomes the opportunity to submit recommendations that will assure the many savings which the use of plastics makes possible.



4 LABORATORY AND TESTING FACILITIES: Whether manufacturers wish to improve production methods, or seek ways and means of testing plastic products to determine their fitness for service, they may obtain the full co-operation of the Bakelite Development Laboratories. The services of technologists are also available for improving existing plastic products or developing new formulas for specialized applications.



5 HUNDREDS OF "BAKELITE" PLASTICS: The large number of BAKELITE materials available enables manufacturers to select the proper plastic for each application. These include Phenolic, Urea, Cellulose-Acetate, and Polystyrene molding materials; laminating varnishes; cast resins; oil-soluble resins; plybond adhesives; air-drying and heat-reactive coatings; bonding resins; impregnating and calendering materials.

6 PRINTED LITERATURE: Helpful technical booklets containing detailed information on BAKELITE Plastics are available without charge. These booklets cover such subjects as BAKELITE molding materials; heat-reactive varnishes for making laminated plastic materials; cast resins; oil-soluble resins for paints and varnishes; plywood bonding materials; and other types for specific industrial needs.

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